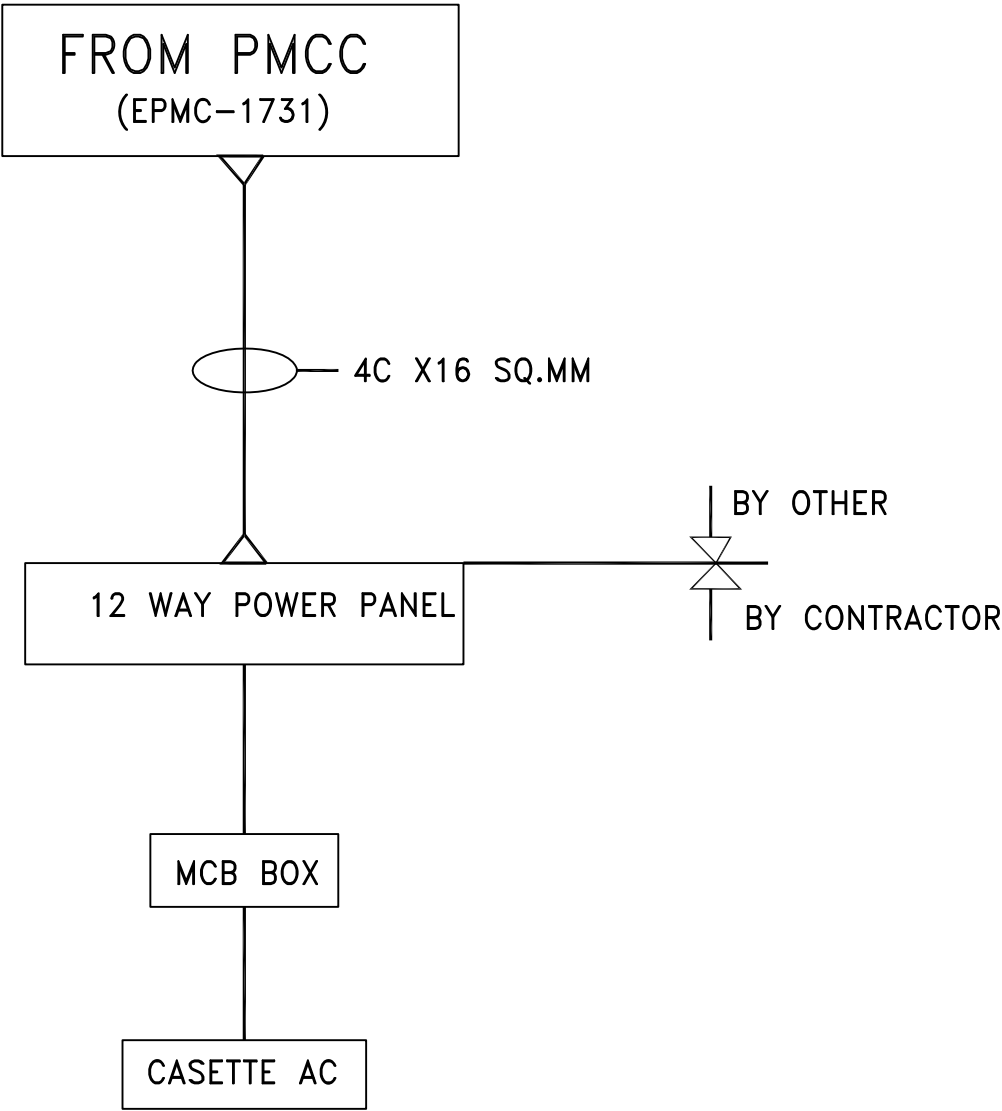


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A4-210X297

PROJECT-RAILWAY SIDING FACILITIES FOR
NAPHTHA UNLOADING

NO.	DATE	REVISIONS	BY	CHK	APPROVALS		
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ENGINEERS INDIA LIMITED
RO-KOLKATA

SCOPE DIVISION

ANNEXURE-I

REV.
A

JOB SPECIFICATION FOR CORROSION PROTECTION TAPE COATING FOR UNDERGROUND STEEL PIPELINES

0	04-03-2010	ISSUED AS JOB SPECIFICATION	SRIDHAR	R CHAUDHURY	R CHAUDHUR
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 SCOPE

This specification covers the requirement for materials, surface preparation, application, inspection, repairs and handling for external corrosion protection tape coating for underground steel pipelines, field joints and coating repair with service temperature upto 60⁰C using, coaltar tape coating .

2.0 REFERENCE DOCUMENTS

The latest edition of the following standards and documents shall apply :

- 2.1 AWWA C-203(latest edition): Coal tar protective coatings and linings for steel water pipelines..
- 2.2 SIS05-5900: Pictorial surface preparation standard for painting steel surface ISO- 8501-1988.
- 2.3 SSPC-SP: Steel structure painting council surface preparation specifications :

SSPC-SP1: Solvent cleaning
SSPC-SP3: Power tool cleaning
SSPC-SP10: Near white metal blast cleaning.

- 2.4 BS: 4164: British Standard Specification for Coal tar based hot applied coating materials for protecting iron and steel including a suitable primer.

3.0 GENERAL REQUIREMENTS

- 3.1 Equipments and accessories required for tape coating shall be in good operating conditions. Adequacy of equipments and accessories shall be ensured by EPCC Contractor and Certified.
- 3.2 Necessary arrangements for power supply and other utilities shall be made for completion of the job.
- 3.3 Necessary testing and inspection facilities as required by this standard shall be developed at site and shall be approved by the PMC/Owner.
- 3.4 Protective tapes and other materials brought to site shall be as per the specifications of this standard and should be approved by the PMC/Owner.

Field and laboratory tests as given in this standard shall be carried out for each batch of primer and tape.

- 3.5 All work shall be carried out in accordance with this specification and shall be phase wise approved by PMC/Owner. Any working procedure developed from this specification shall be approved in advance by the Engineer-in-charge.
- 3.6 Manufacturers recommended/ Trained supervisor and skilled applicator shall be engaged by the contractor for application, inspection and quality assurance.
- 3.7 Applicator shall possess copy of reference documents and test procedure appearing in this standard, which are required for field application.

4.0 DOCUMENTATION

The following documentation is required :

- 4.1 **Before starting up of the work :**
A quality plan with procedures for qualification trials and for the actual work

The quality plan shall include a time table for the various activities, with a description of coating materials to be used, their application, qualification of personnel involved in the work, responsibilities and lines of communications, details of equipment and their calibration, proposed hold points for PMC/Owner inspection and endorsement and the detailed procedures for the testing and inspection.

Documented evidence that the requirements of this specification have been met during production.

4.2 During execution of coating job:

- Daily progress reports on application of tape coating materials with details on weather conditions
- Results of comparison of surface cleanliness, surface profile on blast cleaned surface, Tape coating thickness, holiday detection and adhesion tests.
- Particulars of surface preparation, priming and tape application. No. of wraps
- Details of non-compliance, rejects and repairs.
- Types of testing equipments and calibration.
- Code and batch numbers of coating materials used.
- Field tests on primers and tape coat.
- Progress of work as per scheduled program

5.0 MATERIALS

5.1 General Requirements

5.1.1 Manufacturer's test certificates shall be produced and examined by the PMC/Owner for all materials, proposed to be used for tape coating as per this standard.

5.1.2 All materials brought to site for tape coating shall be suitably marked and identifiable with the following information:

- Manufacturer's name
- Type of material and code
- Batch number
- Date of manufacturing
- Technical datasheet for each type of material
- Shelf life
- Manufacturer's Quality Control test certificates with actual results of each batch.

5.1.3 Materials without manufacturer's test certificates and identification marks shall not be accepted and used.

5.1.4 Test certificate from competent/recognized Algerian Govt. laboratory/in the laboratory of internationally reputed certifying agencies like, Lloyds registrars, DNV (Det Norske Veritas), BV(Bureau Veritas) on the properties of materials quoted by the manufacturer in the technical data sheet shall also be submitted alongwith the Technical Data Sheet of the products. Any recent past certificate can also be submitted

5.1.5 Each batch of primer and tape shall be tested in the field by the procedure as given in this standard. PMC/Owner will review the field test data before use of the materials.

5.2 Characteristics and Functional Requirements of coating materials.

5.2.1 Coal tar tapes

Materials for coal tar tape coating shall conform to the following specifications. The following are the salient features of coal tar tape coating materials.

5.2.1.1 Primer

The primer shall be type B as specified in AWWA C-203 (latest edition). Following are the main characteristics :

• Type	Fast drying, synthetic, chlorinated rubber-synthetic plasticizer-solvent based
• Drying time (Tack free)	15 minutes(approx.) Test Method ASTM D 1640-83/89
• Flash point	> 23 ⁰ C : ASTM D93-90/ D3941-90
• Volatile matter (105-110 ⁰ C) per cent by mass	75 :ASTM D2369-90 (maximum)
• Viscosity, on FORD CUP NO. 4 (4mm nozzle) at 23 ⁰ C	35-60 seconds. ASTM D1200-88
• DFT	25 microns/coat / (minimum)
• Coverage (Theoretical)	10 M ² /Lit/Coat
• Coverage (Practical) @ 25 microns DFT coat	6 M ² /Lit/Coat ASTM D344-89 (minimum)
• Application properties	By brush/ Spray should produce an effective bond between metal and subsequent coaltar tape
• Adhesion test (after 72 hours)	The primer shall be tested after applying Tape coating as per AWWAC-203 (latest edition).

5.2.1.2 Coal Tar Tape

The tape shall be coal-tar component supported on fabric of inorganic fibres.

a) Raw Coal Tar Pitch

The coal tar (hard pitch) component shall be produced from coal that has a minimum heating value of 13000 Btu/lb (7.223x10⁶ cal/kg) on a moisture and mineral matter free basis (ASTM D 388) and that has been carbonised in a slot-type coke oven at a temperature of not less than 900⁰C. The coal tar (hard pitch) shall have the following salient properties:

Softening point ⁰ C	65	121	ASTM D36- 86
Specific gravity	1.30±0.0 5		ASTM D 71-94
Ash content	0.5% Max.		ASTM D 2415-66(1991)
Physical state	Solid at ambient temperature		

b) Fabric

Type : The fabric shall be a thin, flexible, uniform mat or tissue composed of glass fibres in an open structure bonded with a suitable resinous inert material compatible with coal tar.

Weight (min) g/m² 40
Thickness (min.) mm 0.3
Breaking load in the longitudinal direction: 2.28KN/m(min.)

Porosity	When related to pressure difference across the sample, the glass fibre fabric shall have porosity of not less than 0.6mm and not more than 1.9mm of water at an average air velocity of 61m/minute(1m/sec.)
Temperature Resistance	The fabric shall be unaffected under load in hot coal tar at 288°C for one minute. It shall not shrink length wise or width wise
Pliability test	No cracking shall take place when bent over a mandrel of 3mm radius through 90 arc at a uniform speed of approximately 2 seconds after immersing in water for 10 to 15 minutes

Note : (1) Manufacturer's test data in the laboratory are required for the above properties on the materials supplied.

c) Physical properties of coaltar tape.

Property	Requirement		Test method
	Min.	Max.	
Service temperature °C	-	60	
Tape thickness mm	2.0	2.5	Section 8.11.3 of AWWA C-203
Weight average	1.25kg/ sq.m/mm	-	ASTM D146
Breaking strength in longitudinal direction kN/m	0.7		AWWA C-203 10.3.1.2.5
Adhesion	To pass test as per 8.11.2 of AWWA C-203.		
Insoluble content % by wt in petrol.	93% minimum (By procedure given in Annexure-I)		

d) Physical properties of coaltar component in the finish tape.

Property	Requirement		Test method
	Min.	Max.	
Softening point °C	65	121	ASTM D36- 86
Penetration at 25C/100g/ 10 ⁻¹ mm/5 sec	1	9	ASTM D-5/BS-4164
Filler %	20	35	ASTM D 2415. or AWWA C-203 See 8.11.6

e) Filler

Characteristics	Requirement	Test Method
Fineness: % w/w, minimum	Shall pass through mesh size of 75 microns	ASTM D 1366
Loss on ignition at 800° C, w/w max.	10	ASTM D 1208

f) Field Tests

A few test methods, given in Annexure-1 are mainly applicable during field application

6.0 SURFACE PREPARATION

- 6.1 All oil, grease on the pipe metal surface shall be thoroughly removed by flushing with a suitable solvent (such as xylene or 1,1,1 trichloroethylene) and wiping with clean rags. The solvent cleaning shall be as per SSPC-SP-1. If required detergent cleaning shall be done before or after solvent cleaning.
- 6.2 The degreased pipe metal surface shall be blast cleaned to Sa2½ of SIS -05-5900 OR SSPC-SP-10 with a surface profile of 30-50 microns trough to peak. Blasted surface that rusts before priming shall be cleaned by wire brushing or shall be reblasted. Priming shall be done within 4 hours of completion of blast cleaning. Otherwise total reblasting may be necessary.

7.0 APPLICATION OF PRIMER

One coat of primer shall be applied on blast cleaned surface by brush or spray to achieve complete wetting of the surface as recommended by the manufacturer. In case the surface is wet during application of primer the surface should be made dry. The primer shall be allowed to become touch dry prior to tape application. Primer and tape shall be supplied by the same manufacturer.

8.0 TAPE COATING SYSTEM AND APPLICATION

8.1 Tape coating system :

- (a) One coat of fast drying synthetic primer by brush or spray after surface preparation to provide complete wettability of the surface
- (b) One layer of coal tar tape coating with 2mm thickness on the surface of primed pipe after touch dry.
- (c) Second coat of fast drying synthetic primer by brush or spray on 1st layer of tape coating to provide complete wettability of the surface for application of second layer of tape
- (d) Second layer of coal tar tape coating with 2 mm thickness on the surface of primed pipe after touch dry.

8.2 Application Method :

Tape application should follow primer application as soon as the primed pipe surface is touch dry. The primer and tape application should not be done in case of dusty/windy weather or during rain. Primed surface should not be kept exposed to atmosphere for very long duration.

The tape shall be wrapped in accordance with the manufacturer's recommendations in a manner that shall meet the adhesion and holiday detection requirement of this standard. In any event, there shall be a minimum of 12.5mm overlap per single wrap.

The applied coating system shall be as follows :

- (a) In application, care shall be taken that there are no air pockets or bubbles beneath tape and the tape shall be in intimate contact with the primed steel.
- (b) Manufacturer recommended/trained supervisor and skilled applicator shall be engaged for tape application.

9.0 FIELD JOINT COATING AND REPAIR OF DAMAGED COATING:

9.1 Field joint coating on exterior welds:

The exterior joints shall be cleaned and surface preparation by blast cleaning to Sa2½ finish of SIS-05-5900/SSPC-SP-10 as given in clause 6.0. The coating materials shall be same as

applied on as main pipeline. The tape coating material applied on field weld joints shall overlap at least 75 mm the main pipe coating on each side of the field joint to form a continuous external coating free of defects. The coating inspection for quality assurance shall be as given in clause 10.0

9.2 Repair of damaged tape coating:

- 9.2.1 Damages, flawed areas and Holidays: Areas that are damaged, flawed or contain holidays shall be repaired using the tape coating materials applied on main pipeline and made by the same manufacturer. In no case, shall damaged areas be repaired by applying additional tape over loose damaged tape where the damage goes down to the metal or where the bond of the tape has been destroyed.
- 9.2.2 Repair of tape: The repair shall be made by removing the applied tape coating from the area around the holiday. The surface preparation shall be done as per clause 6.0 of this specification and then repair the area by using the same system of primer and hot applied tape as was used for the original wrapping as given in clause 8.0. When completed, the area shall be re-tested following the method of electrical inspection described in clause 10.8.

10.0 INSPECTION AND TESTING FOR QUALITY ASSURANCE

The following stage wise inspection and testing shall be carried out at manufacturers end/at site by the owner or by owner's representative third party inspection agency. However Petrol test vide sec. 2.3 of Annexure-1 and 5.2.1.2 C shall be conducted at EIL R&D centre.

10.1 Fast drying synthetic primer Materials :

As per the physical properties of 5.2.1.1 and procedure given in Annexure-1

10.2 Tape coating

As per 5.2.1.2 (b), (c), & (d) and procedure given in Annexure-1

10.3 Measurement of Pipe thickness(in case of coating refurbishment)

10.4 Surface preparation :

- Blast cleaning equipment for nozzle type, size, Safety gauges, working condition, pressure at the tip of the gun.
- Abrasive type, hardness to provide required profile size and cleanliness.
- Measurement of surface profile and comparing cleanliness with Visual standards of ISO 8501-1988.

10.5 Measurement of pitting depth area of pitted portion, Inspection of weld filling and grinding and patch plate welding, welding of replaced pipe if any.

10.6 Checking of condition of concrete saddles, Rubber padding and end seals wherever required.

10.7 Inspection of primer after application.

- Checking for drying time to be touch dry, tack free drying and hard drying of primer.
- DFT(Dry film thickness) shall be checked on metal panel separately.

10.8 Inspection of Tape coating after application :

- Visual inspection for uniformity without any wrinkles and irregularities and overlapping width as per specifications.
- Adhesion test as per AWWA- C-203.(latest edition)
- H.V. (High voltage) Holiday detection test for pinholes as per AWWA- C203.(latest edition)

10.8.1 Visual

The coated pipes including field joint coating shall be visually inspected for cracks, trapped air, uniformity, damage etc. Any repair arising out of visual inspection will be decided by PMC/Owner.

10.8.2 Thickness

Thickness has to be measured with a caliper with caliper surfaces of at least 20mm diameter, on 5 tape pieces with an edge length of at least 50mm taken from 5 different coils. The measuring pressure should be 0.5N/m². The measuring accuracy should be within 0.1mm.

10.8.3 Adhesion test

- a) Adhesion tests to be made to determine the proper bond between the tape and the primed pipe. One test per section (of upto 10 meter length) shall be carried out initially afterwards adhesion test is to be done as per the advise of PMC/Owner. Repair required due to adhesion testing shall be decided by the PMC/Owner.
- b) Temperature of the tape and pipe to be tested shall be between 10°C and 27°C. If required cold water shall be poured over the test area to bring down the temperature to within the above range. The coating shall be allowed to set at ambient temperature for 72 hrs.
 - A test area shall be selected where the tape is smooth for 150mm in the longitudinal direction of the tape.
 - Two knife cuts of 150mm long and 50mm apart shall be made through the tape.
 - A flat blade shall be used to pry up 50mm of the fabric.
 - The 50mm flap of fabric shall be grasped firmly in one hand and shall be pulled with a quick motion in the direction of the remaining 100mm of the 150mm knife cut.
 - The adhesion is satisfactory if (i) the tape tears at the point of stripping or (ii) the fabric strips from the underlying tape component, leaving no more than 10% or less of the primer or bare metal exposed.
- c) Adhesion between tape to tape can be tested following similar procedure as in (b) However, this should preferably be done on a test panel.

10.8.4 High Voltage holiday detection test

- All tape coated pipes and joints shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- The applied output voltage of the holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20 meters per minutes. The edge effects shall be

ignored. Excessive voltage shall be avoided as it tends to induce holidays in the coated surface thereby giving erroneous readings.

- While selecting test voltages, consideration shall be given to the tolerance on coating thickness and the voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

Thickness of Coating (mm)	Test Voltage(Max.) (kv)
2	10
3	12
4	15

- The electrical equipment used to test tape coating shall be a portable, low amperage, adjustable-voltage, pulse type holiday detector. It shall be furnished with a coil spring electrode or a suitable brush type electrode. The primary input wattage shall not be higher than 20W, and the minimum pulse at crest voltage shall be 20 per second.

11.0 PROTECTION OF COATED PIPES AGAINST UV DEGRADATION:

When the coated pipes are required to be left out exposed to sun light for more than a week before back filling the trench, the coated pipe shall be protected with white coloured water emulsion latex paint. The water emulsion latex paint to be used must be stabilized, pigmented dispersion of water-insoluble film forming, high molecular wt. Synthetic polymeric materials in water. After application and drying the paint must be able to produce a film that adheres to the coal tar tape coating is white in colour, water resistant and able to withstand exterior exposure with out degradation for a minimum of 90 days.

12.0 COAL TAR TAPES AND PRIMER MATERIALS SUPPLIERS

Coal tar tape and primer materials shall be taken from the following EIL recommended vendors

- 12.1 “HIMTAPE” and HIMTAPE PRIMER-C”
HIMADRI CHEMICALS & INDUSTRIES LTD.
23A, Netaji Subhas Road, 8th Floor
Suite No.15, Kolkata-700001.Tel : 033 22209953
- 12.2 MP TAR PRODUCTS
69-70 light industrial Area
BHILAI- CG
- 12.3 B.M CONCOR & CO
15, Bauria Industrial area estate
Chakkashi -711307 Howrah Dist. WB
Tel : 033 26428465
- 12.4 Coatek Coal Tar Tape & Coatek Synthetic primer
Rustech Products Pvt. Ltd.
202/203, Sp[an Land Mark, Opp. Franco Indian Pharmaceuticals
Andheri Kurla Road, Andheri(East)
Mumbai-400093 . phone : 022 28380238/39

13.0 COAL TAR TAPE WIDTH:

The width of coal tar tape coating for various pipe sizes shall be as follows:

PIPE NB	TAPE WIDTH(mm)
80	100/125
100	100/125/166
150	125/166/200
200	125/166/200/250
250	166/200/250/333
300	166/200/250/333
>300	333

ANNEXURE-I

- 1.0 PRIMER : (Fast drying chlorinated rubber based synthetic primer)**
1.1 Test method for volatile content : (Refer to ASTM: D 2369-90 for full details).

Procedure :

A specimen sample of primer 0.50 ± 0.10 gms is weighed into a tared aluminum foil dish into which add 3 ml of solvent toluene technical grade and disperse completely. Heat the above sample in the forced draft oven for 60 mins at $110^{\circ}\text{C} \pm 5^{\circ}\text{C}$. Remove the dishes from the oven place immediately in desiccator, cool to r/t and weigh. calculate the % volatile matter- v.

$$V = \frac{(W_2 - W_1)}{S} \times 100$$

where W_2 - Weight of dish + Specimen
 W_1 - Weight of dish + Specimen after heating
 S - Specimen wt.

- 1.2 Test method for viscosity by Ford Cup No. 4 (Refer to ASTM: D1200-88 for full details)**

The efflux time of primer is determined by FORDCUP no.4. the cup is cleaned thoroughly by solvent toluene and a soft brush. Fill the cup with the primer to full level by holding the orifice with a rubber stopper or finger pull the stopper away and simultaneously start the timer and measure the time until the first break of primer in the orifice. Measure the temperature of the fluid in the efflux stream. Report the efflux time in seconds at a measured temperature.

- 1.3 Test method for drying time; (Refer to ASTM: D 1640-83/ 89 for full details) at ambient temperature:**

Apply the primer by brush on clean glass/clean ms panels of suitable sizes and measure the drying time at a normal room temperature and 50% relative humidity with the coated panels on horizontal position:

- Set-to-touch time :** Lightly touch the test film with the tip of clean finger and immediately place the finger tip against a piece of clean clear glass. Observe if any coating is transferred to the glass. The film is set- to- touch where it still shows a tacky condition, but none of it adheres to the finger.
- Dust free time :** The coating film is considered to have dried dust free when the cotton fibres can be removed by blowing lightly over the surface of film.
- Tack free time :** The film is considered free from after tack when the test paper drops of the test film within 10 seconds.

2.0 COAL TAR TAPE

- 2.1 Test method for relative density of tape : (Refer ASTM: D71-954 for full details)**

The test sample is suspended from a thin wire and weighed first in air, then in water at 25°C in a glass beaker. The relative density is calculated from these weights.

$$\text{Relative density of Tape sample at } 25^{\circ}\text{C} = \frac{a}{(a-b)}$$

where a - weight of specimen in air in mg.
b - weight of specimen in water at 25⁰c in mg.

- 2.2 Test method for adhesion of tape coating in laboratory: (AWWA-C-203): Clean a section of 2 inch dia steel pipe of 2 ft length or a flat steel panel of 2 inch x 6 inch prime the cleaned metal and apply a 2 inch width of tape as per manufacturer's recommendations. The coating shall be allowed to set at room temperature for 72 hrs. after the test sample has completely set, grasp one end of the tape and pull it off by hand. The coating is considered to have satisfactory adhesion if [1] the fabric tears at the point of stripping or (2) the fabric strips from the under lying coating material leaving no more than approximately 10% or less of the primer or bare metal exposed.

2.3 Test method for % wt loss in 24 hrs immersion of tape in petrol

Samples as described below for the test shall be drawn at random in presence of visiting EIL SMMS specialist from the lot delivered at site and the test shall be carried out at EIL R&D centre in presence of EIL

Test method : Weigh accurately about 100gms (2 pieces of tape each 75mm x 75mm size) (wt. A) of tape samples and put this sample in a clean and dry 600 ml capacity glass beaker. Pour 550 ml of petrol into the glass beaker in v-shape form so that the tape sample gets totally immersed in petrol. The level of petrol shall be about 5 cm above the tape sample.

Cover the mouth of the beaker with two layers of thick polyethene sheets and tie these polyethene sheets with a rubber band around the mouth of the glass beaker. Allow the beaker to stand at room temperature for 24 hrs without any disturbance. No stirring is to be done. take the tape sample out of the beaker after 24 hrs and spread it on blotting papers on a table. Allow it to dry in the air for 4 hrs weigh the tape accurately again.(wt. B)

$$\text{Loss in wt. (\%)} = \frac{(A-B) \times 100}{A}$$

$$\% \text{ Insoluble} = \frac{A}{100} - \% \text{ wt. loss.}$$

Carryout the above test simultaneously with 3 more tape samples selected at random and take the average result.

The indicative loss for coaltar tape in petrol shall be 7% maximum.

2.4 Standard test method for relative density of solid hard pitch of coal: (Refer to ASTM: D71-954 for full details). This test is applicable for testing at manufacturer's end.

2.4.1 Summary of test method :

The sample is suspended from a thin wire and weighed, first in air, then submerged in water at 25⁰c. The relative density is calculated from these weights.

$$\text{Relative density of sample at 25}^0\text{c} = \frac{A}{A - B}$$

Where A = Weight of specimens in air in mg.
B = Weight of the specimen in water at 25⁰c in mg.

2.4.2 Procedure :

Tare the balance with a piece of 0.127, (5ml) Nichrome wire or mono-filament nylon line sufficiently long to reach from the hook on the pan. Support to the saddle when the latter is in position across the pan. Attach the test specimen to the wire or line so that it is suspended 20 to 30 mm above the straddle when the other end of the wire is attached to the hook.

Weigh the suspended specimen to the nearest 1 mg. and record this weight as "A". fill a 400 or 600ml baker two thirds full with freshly boiled distilled water containing a small amount of detergent. About 100 mgs. of Alconox detergent to 200 ml of water has been found satisfactory. Adjust the temperature of water to $25 \pm 2^{\circ}\text{C}$ and maintain this temperature during the remainder of the test.. Please the beaker with water on the saddle with the specimen, still suspended, fully submerged. Weight the immersed specimen to the nearest 1 mg. record this weight as "B".

Repeat the determination with the second test specimen.

2.4.3 Report :

Report the average of two determinations to the third place, unless the individual values differ by more than 0.005. In this case, repeat the determinations.

JOB SPECIFICATION FOR SHOP & FIELD PAINTING FOR BCPL, ASSAM

0	17.12.07	ISSUED AS JOB SPECIFICATION BY SMMS DEPARTMENT	DR.DNW	GVS	G.V. SWAMY
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
SS	:	Stainless Steel
GI	:	Galvanized Iron
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
DM	:	De-mineralized
ID	:	Internal Diameter
OD	:	Outside Diameter
NB	:	Nominal Bore
RCC	:	Reinforced Cement Concrete
IRN	:	Inspection Release Note

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1.0 GENERAL

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

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

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

2.0 SCOPE

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

2.1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

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

- a. All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All uninsulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.
- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping

- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
 - i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
 - j. Over insulation surface of equipments and pipes wherever required.
 - k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
 - l. Painting of pre-erection/fabrication and Shop primer.
 - m. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.
 - n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.**
- 2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:
- a. Uninsulated austenitic stainless steel.
 - b. Plastic and/or plastic coated materials
 - c. Non-ferrous materials like aluminum.
- 2.3 **Documents**
- 2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.
- a. Bill of quantities for piping, equipment, machinery and structures etc.
 - b. Piping Line List.
 - c. Painting specifications including special civil defence requirements.
- 2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.
- 2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

- 3.1 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract.

IS-5	:	Colour coding.
RAL DUTCH	:	International Standard for colour shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels.
IS-2379	:	Indian Standard for Pipe line identification-colour code.
ASTM-Vol 6.01 & 6.03:		American standard test methods for Paints and Coatings.
ASA A 13.1-1981:		Scheme for identification of piping systems: American National Standards Institution.

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

- 3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.
- 3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).
- 3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).
- 3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.
- 3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.
- 3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:
- a. Instructions for storage to avoid exposure as well as extremes of temperature.
 - b. Surface preparation prior to painting shall be followed as per Table 8.0 to 16.0 of this specification shall be followed.
 - c. Mixing and thinning.
 - d. Application of paints and recommended limit on time intervals in between coats.

4.0 EQUIPMENT

- 4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data

sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

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

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

- 5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900(latest edition) or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish Standard in case of highly corrosive environment.

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

- 5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of Engineer-in-charge of OWNER/EIL
- 5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.
- 5.1.5 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush.

Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 Procedure of Surface Preparation :

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al_2O_3 particles, chilled cast iron or malleable iron and steel at pressure of $7kg/cm^2$ at a appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron . The combination of steel grits and shots shall be normally in the ratio of 3 : 1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

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

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- a. Hand de-scaling and/or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be bushed, swept, dusted and blow off with compressed

air/steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 Non-Compatible shop coat primer

The paint system followed for Shop coating of structures/equipments etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

- 5.4 Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.
- 5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.
- 5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7 Coating Procedure and Application

- 5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20KM per hour.
- 5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.
- 5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.
- 5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

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

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- h. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.
- j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- k. If spray gun shows choking, immediately de-choking procedure shall be followed.

- 5.7.7 Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

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

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

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

- a. Brushes shall be of a style and quality that will enable proper application of paint.
- b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paint shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be a minimum of brush marks left in the applied paint.
- f. Surfaces not accessible to brushes shall be painted by spray, doublers, or sheepskin.

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

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

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

5.8 Drying of coated surfaces

- 5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.
- 5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.
- 5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 Repair of damaged paint surface

- 5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.
- 5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection pre fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.10 Paint Application

- 5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)
- 5.10.2 Shop priming/ pre-erection priming with F9 or F12 shall be done only with airless spray.
- 5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.10.4 Assessment of painting requirement

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.

- Identify the design temperature from the technical documents
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.11 Documentation

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

TABLE-1 (FOR CLAUSE 5.0)

SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust, loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	profile.				for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

6.0 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, alongwith the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2, 6.3 and 6.4.

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	8-10μ	40-50μ	40-50μ
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	8-10	8-10	8-10	4m ² /kg
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs.	24 hrs.	24 hrs.	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C	NA	80°C	100°C.

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build finish paint.	High build coaltar epoxy coating.
2	Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: polyamide cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum.)	40%.	40%	62%	65%
4	DFT (Dry Film thickness) per coat (minimum)	30-40 μ	30-40 μ	100-125 μ	100-125 μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre(minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C	1 hr.	30 minutes.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	16 hrs 5 days	8 hrs NA	16 hrs 5 days	48 hrs. 5 days
9	Over-coating interval at 30 °C	Min.: 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs.	Not applicable	4-6 hrs	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C	60 °C	80°C	125°C.

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%.	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125μ	65-75μ	20-25μ	20-25μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50% RH	Min.: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum.)	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (min)	80 °C	400 °C	250°C	500°C.

PAINT MATERIALS
TABLE No. 6.4 FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738 from Ameron Products, USA/ Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note: 6	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT (Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100 µm	125- 150 µm
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.16 hrs Max. Not applicable	Min. 16 hrs Max.21 days
10	Pot life at 30°C for two component paints (minimum.)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (min)	-45°C to 125°C under insulation	-45°C to 150°C under insulation (Note: 5)	Up to 400 deg. C for CS & SS surfaces under insulation	-45°C to 150°C for immersion service

NOTES (for tables 6.1 to 6.4):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through SMMS.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. F-15: Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.
6. F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

‘Amercoat 738’ from Ameron Products USA/Kansai Nerolac Paints Ltd. Mumbai, suitable upto 400°C for CS surfaces and 600°C for SS surfaces.

‘Berger 938’ from Berger Paints Ltd Kolkata, suitable upto 400°C for CS & SS surfaces.

‘Intertherm 751’ from Akzo Nobel Coatings and Sealants Pvt Ltd, Bangalore, Inorganic co-polymer cold applied Aluminium spray coating suitable upto 400°C of CS & SS surfaces.

6.5 List of recommended Manufactures

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

7.0 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area, Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSIFICATION

- **Corrosive Environment-Offsite areas** (excluding Cooling Tower area, DM-plant)
- **Corrosive Environment-Unit areas**
- **Highly Corrosive Environment-Unit & Offsite areas** of a plant with corrosive fumes like HCL, H₂SO₄, Water impingement, Salty water, Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes:

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 16.0.
2. Primers & Finish paints covered in Tables 8.0 to 16.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 7.2.

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0 - 16.0

<u>PRIMERS</u>	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based `ZINGA` zinc primer containing 96% of electrolytic zinc dust in dry film.
<u>FINISH COATS/PAINTS</u>	
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with polyamine hardner
F-6B	High Build Epoxy finish coating cured with polyamide hardner
F-7	High build Coal Tar epoxy coating cured with polyamine hardner
F-8	Self priming surface Tolerant High Build epoxy coating, cured with polyamine hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint.
F-14	Specially formulated coaltar epoxy coating, cured with polyamine hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

**TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING
AFTER ERECTION/WELDING** for all insulated and un-insulated CS, LTCS & low
allow steel items in all environments. (refer clauses 5.4, 5.5 & 5.9)

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40µ DFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.3	401 to 550	SSPC-SP-3	1 coat of F-12	20	-DO-

NOTES:

- 1 The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advise re-blasting and priming again if required.
- 2 The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

TABLE 8.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFFSITE AREAS (excluding Cooling Tower area & DM Plant area) for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
8.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
8.2	-14 to 60	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-2 @ 40 μ DFT/coat	2 coats of F-3 @ 40 μ DFT/coat ; (2x40=80)	185	
8.3	61 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245	F-3 paint shall contain pure chlorinated rubber, not modified.
8.4	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	3 coats of F-11 @ 20 μ DFT/coat; (3x20=60)	125	F-12 shall be ambient temperature curing type
8.5	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	Flare lines shall be painted as per Table 9.0.
8.6	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40)	60	

NOTES

- The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.
- For external surfaces of RCC chimney: 2 coats of F-6 @ 100 μ DFT/coat to obtain 2x100=200 μ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.
- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2
- In case of Paint systems as per Sl Nos 8.5 and 8.6, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 18.0.

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS
for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
9.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6A @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245-255	
9.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @50 μ DFT/coat.	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per Sl Nos 9.3 and 9.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCL, H₂SO₄, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipments, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc(Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
10.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
10.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	2 coat of F-6A @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (2x100+40=240)	345-255	
10.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat 2x20=40 or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	
10.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat; (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per Sl Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 11.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS (EXTERNAL)
All areas (Units & Offsites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
11.1	All external surfaces of shell, internal surfaces of shell above maximum liquid level exposed to atmosphere, wind girders, appurtenances, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasolene, motor spirit, DM water, firewater, raw water, potable water, acids, alkalis, solvents and chemicals etc.					
11.1.1	-14 to 80	SSPC-SP-10;	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 coats of F-6A @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat; (2x100+40=240)	345-355	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat; (80+40=120)	280	
11.1.3	151TO 500	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	2 coats of F-12 @ 20µ DFT/coat; (2x20=40) or 1 coat of F-16 @ 50µ DFT/coat	105-115 OR 115-125	F-12 shall be ambient temperature curing type
11.2	External surfaces of bottom plate (soil side) for all storage tanks.					
11.2.1	-14 TO 80	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
11.2.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	

NOTES

- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

**TABLE 12.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (INTERNAL)
All Areas (Units & Offsites)**

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 1meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing crude oil, LDO, HSD and Gas Oil (Excluding white oil products)					
12.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 Coats of F-6A @ 100µ DFT/coat; (2x100=200)	305-315	Note-2
12.2	Inside of bare shell of floating roof tanks and cone roof tanks for items mentioned in 12.1					
12.2.1	-14 TO 80	SSPC-SP-10	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	2 coats	DFT need not be measured reconciliation of Chemical used shall be done (Note : 4)
12.3	Floating / Cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, bottom course upto 4 meters height inside shell, underside of floating roof and shell above maximum liquid level, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
12.3.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @ 100µ DFT/ coat; (3x100=300)	365-375	Note-2
12.4	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.3.					
12.4.1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	
12.5	Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.					
12.5.1	-14 to 80	SSPC-SP-10	2 Coats of P-6 @ 40µ DFT/coat; (2x40=80)	2 Coats of F-6B @ 100µ DFT/ Coat; (2x100=200)	280	Note-2
12.6	D.M. (De-mineralized water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories					
12.6.1	-14 to 60	SSPC-SP-10	None	Natural Rubber lining as per SMMS specifications 6-06-204	4.5MM	For DM tanks without steam blanketing
12.6.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	For DM tanks with steam blanketing
12.7	EG(Ethylene Glycol) tanks (internal shell, bottom plate roof and all accessories)					
12.7.1	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer Amercoat 23 @ 75µ /Coat ; (3x75=225)	225	

12.8	Inside pontoon and inside of double deck of all floating roofs.					
12.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	
12.9	Internal surfaces of wet slop, amine, sour water, water draw off storage tanks					
12.9.1	-14 TO 80	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat; (80+80=160)	240	
12.10	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 4meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing Vacuum Residue, Fuel oil, dry slop and other high temperature hydrocarbon liquids.					
12.10.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @ 125μ DFT/ coat; (125+125=250)	375	Note:3
12.11	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.10					
12.11.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	None	125	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
2. F-6A/F6B should be suitable for immersion service of the products given.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is upto 200°C. Cases of operating temperature > 150°C **are not covered in this spec, such cases shall be covered in the job specifications.**
4. The phosphating chemical shall be applied on blast cleaned surface inside the shell of carbon steel storage tanks at the time of erection. In case, any corrosion is observed at the time of commissioning, 2 coats of the phosphating chemical shall be applied at the discretion of Engineer-in-charge.

TABLE 13.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND TANKS IN ALL AREAS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Underground carbon steel plant piping (Yard/ Over the Ditch Corrosion protection Coating)					
13.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25 @μ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @μ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Spec.No 6-79-0011	4 mm	
13.2	Carbon steel plant piping (underground).					
13.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	
13.3	External side of un-insulated underground storage tanks:					
13.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	
13.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	

TABLE 14.0 PAINTING UNDER INSULATION (ALL ENVIRONMENTS)
All areas (Units & Offsites) for insulated Piping, Storage Tanks, Equipments etc
(Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Insulated carbon steel, LTCS and low allow steel Piping, Storage Tanks, Equipment etc					
14.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-14 @ 125µ DFT/coat; (2x125=250) or 3 coats of F-15 @ 80µ DFT/coat ; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking.
14.1.2	126-400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 @ 20µ DFT/coat; (3x20=60) or 1 coat F-16 @ 60 µ DFT/coat	125 – 135	F-12 shall be ambient temperature curing type
14.2	Insulated stainless steel including Alloy-20 piping (Note:2)					
14.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 coats of F-14 @ 125µ DFT/coat;	250	
	0 to 125 (alternate)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15@ 80µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
14.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16@ 125 µ DFT/coat	None	1 coat of F-16@ 125 µ DFT/coat	250	
14.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for the temperature of 600 deg.C and cyclic temperature.
14.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP-10 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	
14.3	No painting is required for insulated monel, incoloy and nickel lines.					

NOTES

1. Refer Notes 1 & 4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to 125 deg.C, both 14.2.1 & 14.2.2 are applicable.

TABLE 15.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS / CONDENSERS
 Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Upto 65	SSPC-SP-10; 1 coat of P-6 @ 40μ DFT/coat	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	290	For CS surfaces
15.2	Upto 65	SSPC-SP-3; 1 coat of P-4 @8-10μ DFT/ coat+ 1coat of P- 6 @ 40μ DFT/coat.	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 16.0 PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
16.1	Upto 65	SSPS-SP-3	1 coat of P-4 @8-10μ DFT/ coat + 1 coat of P-6 @ 40μ DFT/coat	2 coats of F-2 @ 40μ DFT/coat; (2x40=80)	130	Shade as per defence requirements
16.2	Upto 65	SSPS-SP-3	1 coat of P-4 @ 8μ DFT/coat.+ 1 coat of P-6 @ 40μ DFT/coat.	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

17.0 STORAGE

- 17.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word “PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE” shall be clearly displayed outside. Manufacturer’s recommendation shall be followed for storage of paint materials.

18.0 PIPING COLOUR CODE:

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

18.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

- 18.1.1 The following ground colour designation for identification of basic classification of various important services shall be followed:

Post Office Red	-	Fire protection materials
Off White/Aluminium	-	Steam (all pressures)
Canary Yellow	-	Chemicals and dangerous materials
Dark Admiralty Grey	-	Crude oil, lube oil
Orange	-	Volatile petroleum products (motor spirit and lighter)
Oxide red	-	Non-volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	-	Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	-	Water (all purities and temperatures)
Sea green	-	Air and its components and Freon

- 18.1.2 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

18.2 COLOUR BANDS AND IDENTIFICATION LETTERING

- 18.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black

letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm wide and regardless of band width, are spaced 25 mm apart when two bands are employed

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel	:	150 mm (Height)
Pump, compressor and other machinery	:	50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

18.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

18.2.3 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

18.2.4 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

18.2.5 Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

18.2.6 Colour band specification:

- | | |
|---------------|------------------------------------|
| a) Unit Area: | Bands at intervals of 6.0 meters. |
| Offsite Area: | Bands at intervals of 10.0 meters. |

- b) Each pipe segment will have minimum one band indication, irrespective of length.
- c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.
- 18.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½” wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.
- 18.4 In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.
- 18.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

RECOMMENDED RAL COLOUR CODE FOR PAINTING OF PIPING AND EQUIPMENT

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE			
			BASE COLOUR		BAND COLOUR	
HYDROCARBON LINES (UNINSULATED)						
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012		2011	
2	CRUDE SWEET	Dark Admiralty grey with 1 red band	7012		3001	
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012		6010	
4	FLARE LINES	Heat Resistant Aluminium	9006			
5	LPG	Orange with 1 oxide red band	2011		3009	
6	PROPYLENE	Orange with 2 blue bands	2011		5013	
7	NAPHTHA	Orange with 1 green band	2011		6010	
8	M.S.	Orange with 1 dark admiralty grey band	2011		7012	
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011	6010	9010	3001
10	GASOLINE (regular, leaded)	Orange with 1 black band	2011		9005	
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011		5013	
12	GASOLINE (white)	Orange with 1 white band	2011		9010	
13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011		3001	
14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011		4006	
15	N-PENTANE	Orange with 2 blue bands	2011		5013	

16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
25	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Black with 1 orange band	9005	2011
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
CHEMICAL LINES				
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000
41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013
48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031

WATER LINES				
51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 yellow bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
FIRE PROTECTION SYSTEM (ABOVE GROUND)				
63	FIRE WATER FOAM & EXTINGUISHERS	Post office red	3002	
AIR & OTHER GAS LINES (UNINSULATED)				
64	SERVICE AIR	Sea green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Sea green with 1 black band	6018	9005
66	NITROGEN	Sea green with 1 orange band	6018	2011
67	FREON	Sea green with 1 yellow band	6018	1023
68	CHLORINE	Canary yellow with 1 oxide band	1012	3009
69	SO ₂	Canary yellow with 2 white bands	1012	9010
70	H ₂ S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021
STEAM AND CONDENSATE LINES (UNINSULATED)				
75	HP STEAM	Off white / Aluminum with 1 yellow band	9006	1023
76	MP STEAM	Off white / Aluminum with 1 red band	9006	3001
77	MLP STEAM	Off white / Aluminum with 1 orange band	9006	2011
78	LP STEAM	Off white / Aluminum with 1 light green band	9006	6021

79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 red bands	5015	3001
Note: For all insulated steam lines, the colour coding shall be follow as given for un-insulated lines with the specified length of color bands.				
INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	1Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001
86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013
90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001
93	CRUDE OUR	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Steel grey	7011	
97	HEATER CASING	Heat resistant aluminium	9006	
98	VESSELS & COLUMNS	Aluminium	9006	
99	HYDROGEN BULLETS	Pink	3014	
100	LPG VESSELS	Oxide red	3009	
101	SO ₂ VESSEL	Canary yellow	1012	
102	HEAT EXCHANGER	Heat resistant aluminium	9006	
103	FO TANK AND HOT TANKS	Black	9005	
104	ALL OTHER TANKS	Aluminum / Off white	9006	

105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004
106	SOUR WATER	Sky Blue	5015
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006
108	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012
109	PUMPS	Navy blue	5014
110	MOTORS & SWITCH GEAR	Bluish green	5024
111	HAND RAILING	Signal red	3001
112	STAIRCASE, LADDER AND WALKWAYS	Black	9005
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
114	GENERAL STRUCTURE	Black	9005
PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
115	IBR	Signal red	3001
116	9Cr-1Mo	Verdigris green	6021
117	5Cr-0.5Mo	Satin blue	5012
118	2 $\frac{1}{4}$ Cr-1 Mo	Aircraft yellow	1026
119	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	Traffic Yellow	1023
120	SS-304	Dark blue grey	5008
121	SS-316	Dark violet	4005
122	SS-321	Navy blue	5014
SAFETY COLOUR SCHEMES			
123	DANGEROUS OBSTRUCTION	Black and alert orange band	9005 2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008

19.0 IDENTIFICATION OF VESSELS, PIPING ETC.

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

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

19.2 Identification of storage tanks:

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

20.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

- 20.1 Following items shall be painted for camouflaging if required by the client.
- All Columns
 - All tanks in Offsites
 - Large Vessels
 - Spheres
- 20.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.
- 20.3 **Method of Camouflaging**
- 20.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).
- | | | |
|------------|-------------|-------------------|
| Dark Green | Light Green | Dark Medium Brown |
| 5: | 3: | 2 |
- 20.3.2 The patches should be asymmetrical and irregular.
- 20.3.3 The patches should be inclined at 30° to 60° to the horizontal.
- 20.3.3 The patches should be continuous where two surfaces meet at an angle.
- 20.3.4 The patches should not coincide with corners.
- 20.3.5 Slits and holes shall be painted in dark shades.
- 20.3.6 Width of patches should be 1 to 2 meters.

21.0 INSPECTION AND TESTING

- 21.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.
- 21.2 Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.
- The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.
- 21.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

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

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

21.4 **Primer Application**

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

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

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

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

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

21.8 At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

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

21.10 The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

22.0 GUARANTEE

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

23.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor who is awarded any job for EIL, Projects under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

24.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

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

- 24.1 The manufacturer should arrange testing of the coating materials as per the list of tests given in para 24.4 below from one of the reputed Government laboratories.
- 24.2 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.
- 24.3 All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed alongwith test report.

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

IICT, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
UICT, Matunga, Mumbai
RITES, Kolkata
PDIL, Sindri
NTH, Kolkata

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

Test required for evaluation of acceptance of coating materials for onshore application.

<u>Test</u>	<u>ASTM Test Method</u>
Density	D 1475
Dipping properties	D 823
Film characteristics	
Drying time	D 1640
Flexibility	D 1737/D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt spray 2000 hrs	B 117
Accelerated Weathering	D 822
% Zn in Dry film for Inorganic Zinc	G 53
Silicate primer	

24.5 Coating systems for panel test shall be decided after discussion with EIL.

24.6 Clause No. 24.0 is for approval prior to award of the contract. In case any agency proposes for any fresh approval after award of work, the same shall have no time implications upon the contract.

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS

Indian Vendors

1. Asian Paints (I) Ltd., Mumbai
2. Berger paints Ltd., Kolkata
3. Kansai Nerolac Paints Ltd., Mumbai (including Ameron, USA Products).
4. Chugoku Marine Paints Pvt. Ltd., Mumbai
5. Shalimar Paints Ltd., Kolkata
6. Sigma Kalon Marine and Protective Coatings(India) Pvt Ltd, Mumbai.
7. CDC Carboline Ltd., Chennai
8. Premier products Ltd., Mumbai
9. Coromandel Paints & Chemicals Ltd., Visakhapatnam
10. Anupam Enterprises, Kolkata
11. Grand Polycoats, Vadodara
12. Bombay Paints Ltd., Mumbai
13. Akzo Nobel Coatings and Sealants Pvt. Ltd., Bangalore
14. Cipy Polyurethanes Pvt. Ltd., Pune
15. Gunjan Paints Ltd., Ahmedabad
16. Advance Paints Ltd., Mumbai
17. VCM Polyurethane Paints (for polyurethane paints only)
18. Jotun Paints India Pvt Ltd, Chennai(Singapore)
19. Paladin Paints and Chemicals , Mumbai
20. Chembond Chemicals Pvt Ltd , Navi Mumbai
21. Aashish Coating Technologies Pvt. Ltd, Vadodara/Mumbai

Foreign Vendors

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

The following are approved for specific materials only.

- 1.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only).
- 2.0 ChemTreat India Ltd.(for Phosphating Chemical and glass flake filled coatings of M/s Atlas Chemicals Corporation, USA).
- 3.0 Carolina equipment and supply Co., USA.
- 4.0 Zinga Metall(Rozenstraat 4-Industrial Zone)-9810 EKE-Belgium, Indian Agent-Newkem, Mumbai-14 (for cold spray zinc coating)

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURERS' PRODUCTS

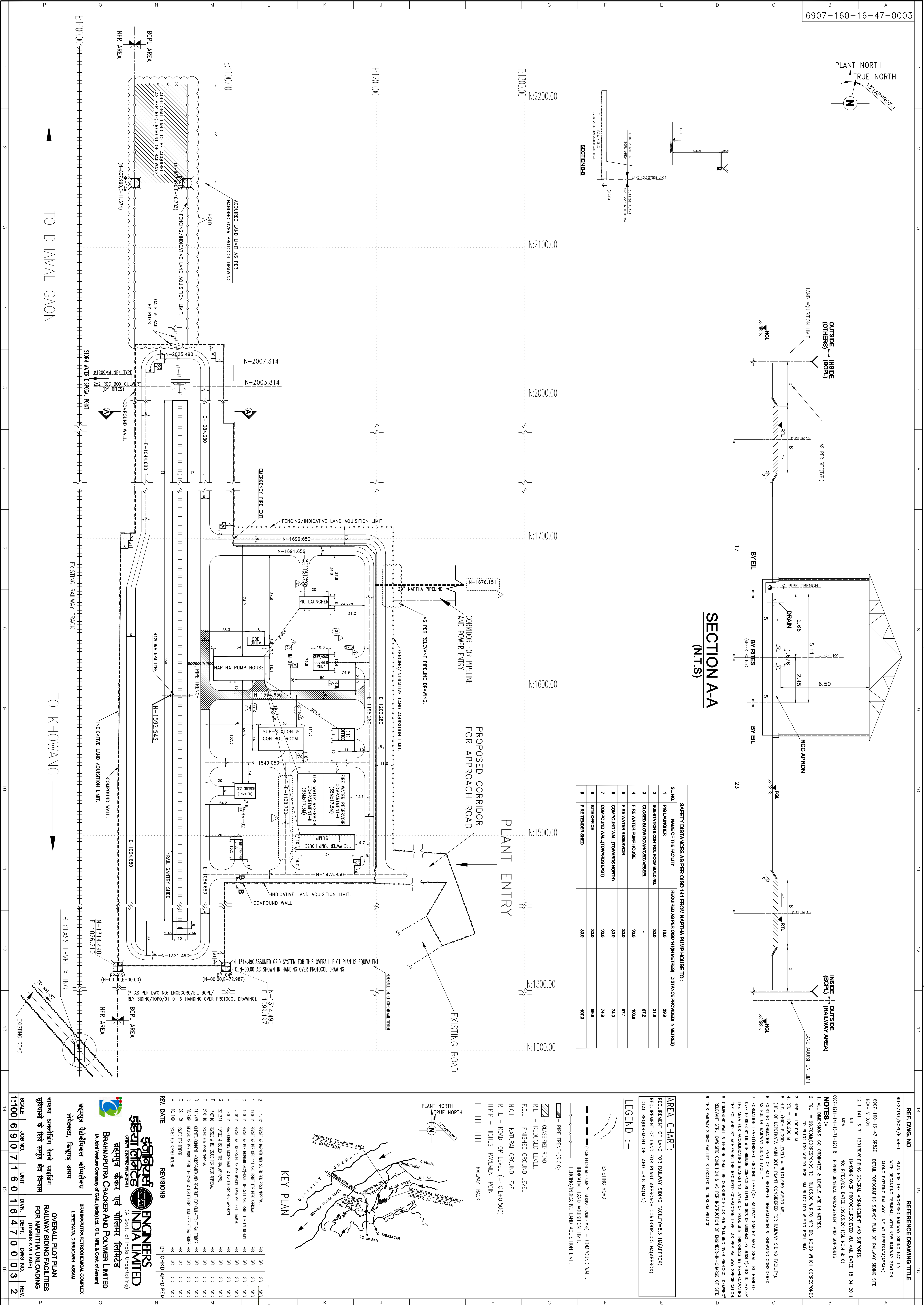
Sl. No	Manufacturers Name	P2 Chlorinated Rubber Zinc Ph Primer	P4 Etch Primer/ Wash Primer	P6 Epoxy Zinc Ph. Primer	F9 Inorganic Zinc Silicate Primer/ Coating
1	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH.PRIMER RO PC 168	APCONYL WP636 (PC335)	APCODUR HB.ZP. PC433	APCOSIL 605
2	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610 HB PRIMER	ZINC ANODE 304 MZS
3	AMERON PRODUCTS	-	AMERCOAT 178	AMERCOAT 71/385P	DIMETCOTE-9FT
4	CHEMBOND CHEMICALS	KEMCHLOR 201	KEMGALVA GRIP A1	KEMOXY 301	KEMGUARD 501
5	SHALIMAR PAINTS LTD	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILIKATE
6	SIGMA KALON INDIA PVT LTD,	SIGMA NUCOL UNICOAT 7321	SIGMA ETCH PRIMER (7185)	SIGMA COVER 256 (7412)	SIGMAZINC- 158
7	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8	PREMIER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB.ZN.PH PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN.PH. HIGH BILD PRIMER	CPC INORGANIC ZINC SILICATE PRIMER
10	ANUPAM ENTERPRISES	ANUHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	ANUZINC 2001 TP
11	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401	-	GP PRIME 402
12	BOMBAY PAINTS LTD.	PENTA CHLOR HB PRIMER 8632	PENTOLITE WASH PRIMER 8520	PENTADUR PRIMER 8530	ZINC-O-SIL 75
13	HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	-	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
14	AASHISH COATING TECH-NOLOGIES				
15	AKZO NOBEL PAINTS	-	-	INTERGARD 251	INTERZINC 12/22
16	PALADIN PAINTS	VEGCHLOR HB PRIMER 1143	VEGWASH PRIMER 1181	VEGPOX 1241ZP	THERMOSIL1362 ZINC
17	VCM POLYURETHANE PAINTS				
18	JOTUN PAINTS		JOTA ETCH TWO PACK WASH PRIMER	EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	RESIST-86
19	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	CHUGOKU MARINE PAINTS PVT. LTD.	-	-	CAMIDECK PRIMER	GALBONS HB
21.	KANSAI NEROLAC PAINTS LTD.	NEROLAC HB CR ZINC PHOSPHATE PRIMER	NEROLAC ETCH PRIMER	NEROLAC EPOXY ZINC PHOSPHATE PRIMER	NEROSIL 118

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (Cont. ...)

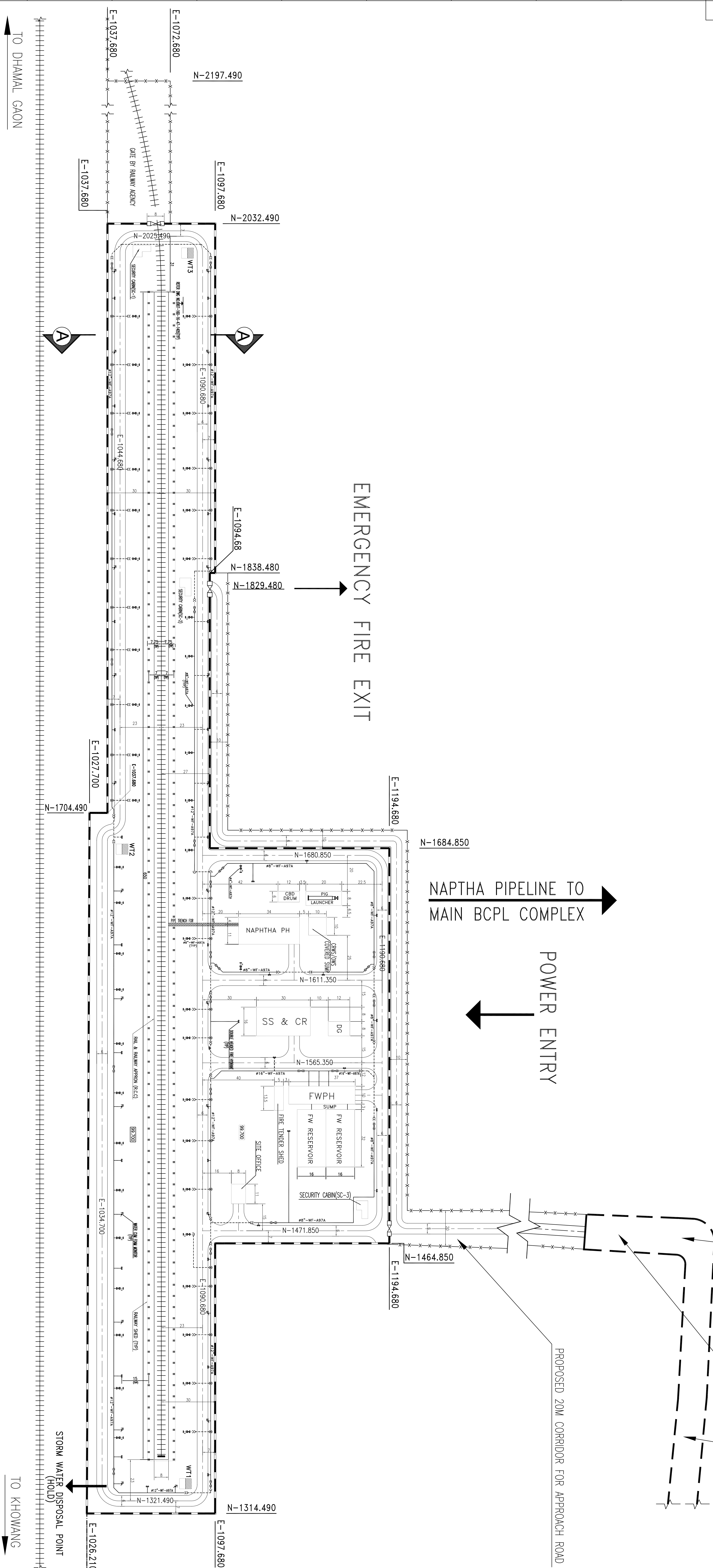
Sl. No	Manufacturers Name	F2 Acrylic-Polyurethane Finish Paint	F3 Chlorinated Rubber Finish Paint	F6A/B High Build Epoxy Finish Paint	F7 High Build Coal Tar Epoxy Coating
1	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 319)	APCODUR HB COATING PC 1262	APCODUR CF 651/655(PC 131/471)
2	BERGER PAINTS LTD.	BERGER ACRYLIC PU FINISH	LINOSOL CHLORINATED RUBBER HB COATING	EPLIUX 04 AND 78 HB EPOXY COATING	EPILUX 555
3	AMERON	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
4	CHEMBOND CHEMICALS	KEMTHANE 411	KEMCHLOR 211	KEMOXY 324	KEMOXY 314
5	SHALIMAR PAINTS LTD	SHALITHANE FINISH	CHLORKOTE HB FINISH	EPIGARD TL FINISH POLYAMINE/ POLYAMIDE	BIPIGARD CTE ZL BLACK HB COAL TAR EPOXY COATING
6	SIGMA COATINGS.	SIGMADUR GLOSS (7528)	SIGMA NUCOL FINISH 7308	SIGMA GUARD 720	SIGMACOVER 300 (7472)
7	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBO-MASTIC-14
8	PREMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350/3A, COAL TAR EPOXY COATING
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROTHANE SUPER PU FINISH	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11	GRAND POLYCOATS	GP BOND 141	GP CHLOROGAURD 631	GP GUARD HP234	POLYGUARD CE
12	BOMBAY PAINTS LTD.	PENTATHANE FP 4510	PENTACHLOR FB 4635	PENTADUR HB 5540/5520	PENTADUR COALTAR EPOXY 8518/6518
13.	HEMPEL MARINE PAINTS	-	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
14.	AASHISH COATING TECH	GA 1110 PU-UB		GA701 HB	
15	AKZO NOBEL COAITNGS	INTERTHANE 990	-	INTERGARD 966 / 410	INTERTUF 262 (TAR FREE TYPE)
16	PALADIN PAINTS	VEGTHANE (ALIPHATIC)	VEGCHLOR FP3140	VEGEPOX 3245/3562	VEGEPOX 4265
17	VCM POLYURETHANE PAINTS	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18	JOTUN PAINTS	HARDTOP XP		PENGUARD HB	JOTAGUARD 85
19	KCC PRODUCTS (KOREA)			KOEPOX TOPCOAT HB ET 5740	EH 173
20.	CHUKOGU MARINE PAINTS PVT LTD.	UNY MARINE	-	EPICON MARINE FINISH HB	BISCON HB 2001/ACHB
21.	KANSAI NEROLAC PAINTS	NEROTHANE ENAMEL	NEROLAC HB CHLORINATED RUBBER ENAMEL	NEROPOXY HB 262/6061	NEROLAC EPOXY COAL TAR POLYAMINE/POLY AMIDE CURED.

Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.

प्रस्तुत आरेख एवं इसमें निहित विधान इंजीनियर्स इंडिया लिमिटेड की संपत्ति है। ये मात्र उधार दिए गए हैं और उधारकर्ता ने यह स्पष्ट समझौता किया है कि न तो उन्हें पुनः मुद्रित किया जाएगा, न नकल की जाएगी, न उधार दिए जाएंगे, न प्रदर्शित किए जाएंगे और न ही सीमित और निजी प्रयोग के अलावा इनका कोई अन्य प्रयोग होगा और यह प्रयोग उधार देने वाले द्वारा उधारकर्ता को लिखित रूप में दी गई सहमति से होगा।
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6907-160-16-47-0402



LIST OF HYDRANTS/MONITORS (FOR PROTECTED BLOCKS)

BLOCK/AREA	PERIMETER (M)	NO. OF HYDRANTS		NO. OF MONITORS		REMARKS
		REQD. AS PER OSD/MAC	PROVIDED	REQD. AS PER OSD/MAC	PROVIDED	
NAPTHA PUMP HOUSE	98	4	4	-	-	-
PIG LAUNCHER	56	2	1	-	-	1 HYDRANT COMMON WITH NAPTHA PUMP HOUSE.
SUB-STATION & CONTROL ROOM	92	3	2	-	-	1 HYDRANT COMMON WITH NAPTHA PUMP HOUSE.
DG SHED	40	1	-	-	-	-
FIRE WATER PUMP HOUSE	94	3	3	-	-	-
FIRE TENDER SHED	37	1	-	-	-	1 HYDRANT COMMON WITH SUB STATION & CONTROL ROOM
SITE OFFICE	38	1	1	-	-	-
RAILWAY GANTRY	1448	25	25	25	26	-

REF. DWG. NO.	REFERENCE DRAWING TITLE
3507-180-16-d-46003	OVERALL PLOT PLAN POLYVAI SIDING FACILITIES FOR NAPHTHA UNLOADING

NOTES :-

1. ALL DIMENSIONS, CO-ORDINATES & LEVELS ARE IN METRES.
2. FGL = 99.700 M CORRESPONDS TO RL= 102.100M.
3. TRUE NORTH SHALL BE PROVIDED BY SURVEY CONTRACTOR.
4. I.P.P = 100.000 M CORRESPONDS TO RL = 102.00M.
5. ALL FIRE FIGHTING EQUIPMENTS SHALL CONFORM TO RELEVANT INDIAN INTERNATIONAL STANDARDS & MANUFACTURED BY TAGNISI APPROVED VENDORS.
6. UNDER GROUND PIPES SHALL BE PROVIDED WITH TAPE COATING AS PER SPECIFICATIONS NO. 6907-6642-CT/TP-6 C/10 AND SHALL BE BURIED WITH A MINIMUM CLEAR COVER OF 1.1m FROM FGL, UNDER ROAD, CLEAR COVER PIPE SHALL BE 120mm OR DIA OF PIPE WHATEVER IS HIGHER.
7. ALL FIRE WATER LINES UNDER ROAD CROSSING UNDER APPROACH ROADS SHALL BE LAID UNDERGROUND THROUGHOUT ON PIPE SLEEVES CLEAR COVER OVER PIPE SHALL BE 120mm OR DIA OF PIPE WHATEVER IS HIGHER.
8. HOSE CABBINETS ALONG WITH TWO HOSE PIPES AND NECESSARY ACCESSORIES AS PER SPECIFICATIONS SHALL BE INSTALLED BY ROAD SIDES AT EACH HYDRANT LOCATIONS.
9. ALL ABOVE ROAD FIRE WATER LINES SHALL BE SUPPORTED ON RCC SLEEPERS 400 mm ABOVE FINISHED GRADE LEVEL(FGL).
10. ATLEAST 10% OF ALL JOINTS RADIO GRAPHICALLY TESTED & HALF OF THE JOINTS RADIOGRAPHED SHALL BE FIELD JOINTS AS PER ITC REQUIREMENTS.
11. SPACING OF SLEEPERS SHALL BE PROVIDED AS FOLLOWS:-
 - a) F & ABOVE = 5M (MAX) CC
 - b) FGL & F = 3M (MAX) CC
12. SPACING OF HYDRANT & MONITOR SHALL BE PROVIDED AS FOLLOWS:-
 - a) UNDER RAILWAY GANTTRY - FIRE HYDRANTS & WATER CUM FOAM MONITOR- SHALL BE PROVIDED ALTERNATELY @ 30M CC
 - b) OTHER FACILITIES - FIRE HYDRANTS @ 50m CC

LEGEND :-

- DOUBLE HEADED FIRE HYDRANT
- WATER CUM FOAM MONITOR HAVING MULTIPURPOSE COMBINATION NOZZLES FOR JET SPRAY & FOG ARRANGEMENT

- CC - 45° PIPE BEND

- U/G PIPE A/G PIPE

- GATE VALVE

99.700 – F.G.L

CONSTRUCTION SHALL BE DONE AS PER CIVIL GENERAL ARRANGEMENT DRAWINGS

0	21.07.10	ISSUED FOR ENGINEERING	PB	GG	AKG
REV	DATE	REVISIONS	BY	CHKD APPD	REMOVED

**इंजीनियर्स
इंडिया लिमिटेड**
(A Public Limited Company)
**ENGINEERS
INDIA LIMITED**
(A Govt. of India Undertaking)

(A Govt. of India Undertaking)

ब्रह्मपुत्र कैकर एवं पोलिमर लिमिटेड

ब्रह्मपुत्र कैंकर एवं पोलिमर लिमिटेड
BRAHMAPUTRA CRACKER AND POLYMER LIMITED
(A Joint Venture Company of GAIL (India) Ltd., OIL, NRI & Govt. of Assam)

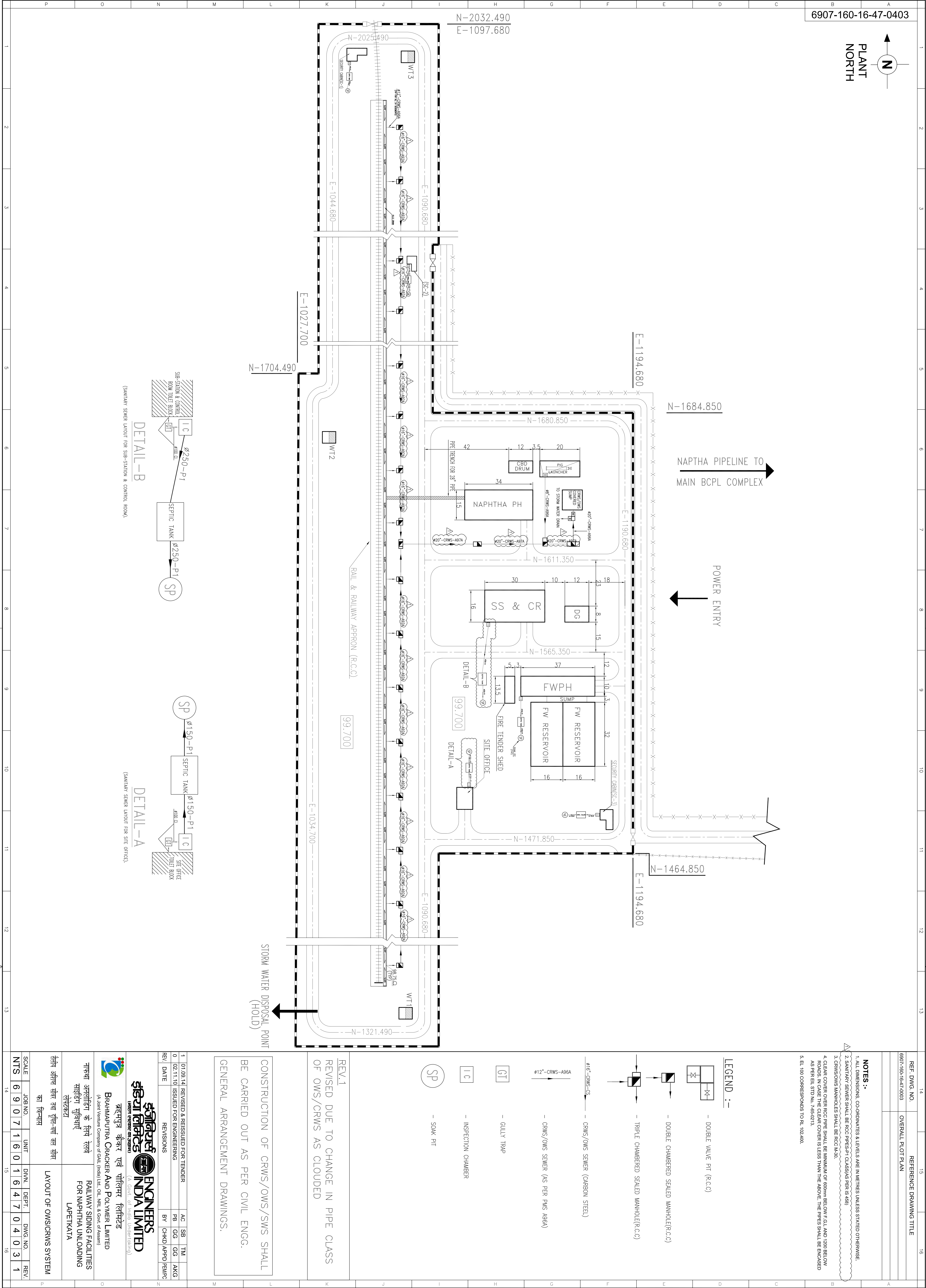
ताम्रधा अमलोडिंग रेलवे साईडिंग सुविधाएँ लेपेटकाट, डिब्रूगढ़, असम	RAILWAY SIDING FACILITIES FOR NAPHTHA UNLOADING LEPETKATA, DIBRUGARH ASSAM
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अग्निश्मन जल प्रणाली का विन्दास

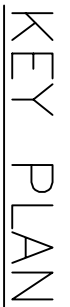
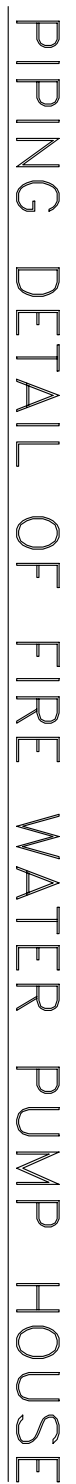
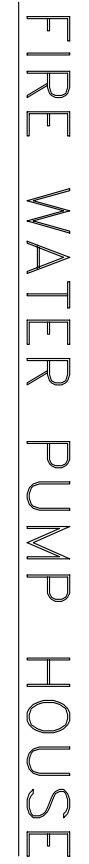
SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1/8" = 1'-0"	0000000000	0000000000	0000000000	0000000000	0000000000	0000000000

प्रस्तुत आरेख एवं इसमें निहित डिजाइन इंजीनियर्स इंडिया लिमिटेड की संपत्ति है। ये मात्र उधार दिए गए हैं और उधारकर्ता ने यह स्पष्ट समझौता किया है कि न तो उन्हें पुनः मुद्रित किया जाएगा, न नकल की जाएगी, न उधार दिए जाएंगे, न प्रचलित किए जाएंगे और न ही सीमित और निजी प्रयोग के अलावा इनका कोई अन्य प्रयोग होगा और वह प्रयोग उधार देने वाले द्वारा उधारकर्ता को लिखित रूप में से गई सहमति से होगा ।

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REV.	DATE	REVISIONS	BY	CHKD	APPD	PEN/PC
B	05.08.10	ISSUED WITH COMPOSITE TENDER	TM	PB/GG	GG	AKG
A	28.07.10	ISSUED FOR PUMP VENDOR	TM	PB/GG	GG	AKG

इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)



ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

 **BPL** ब्रह्मपुत्र कैंकर एवं पोलिमर लिमिटेड
BRAHMAPUTRA CRACKER AND POLYMER LIMITED
(A Joint Venture Company of GAIL (India) Ltd., OIL, NH & Govt. of Assam)

नाफथा अनलोडिंग के लिये रेलवे
साइडिंग सुविधाएँ
लेपटकाटा

RAILWAY SIDING FACILITIES
FOR NAPHTHA UNLOADING
LAPEKATA

FIRE WATER PUMP HOUSE,SUMPS & RESERVOIR
ARE IN THE SCOPE OF OTHERS

1. ALL DIMENSIONS ARE IN MM EXCEPT LEVELS WHICH IS IN M.
2. 5 TON CAPACITY H.O.T CRANE SHALL BE PROVIDED IN THE FIRE WATER PUMP HOUSE.
3. PUDDLE FLANGE SHALL BE PROVIDED FOR ALL PIPES CROSSING THE WALL.
4. COUPLING WRAPPING AS PER IS STD. NO: 6807-06+2-CITATE-C10 SHALL BE PROVIDED FOR ALL UNDERGROUND PIPES.

REF. DWG. NO.	15	16
6907-160-16-47-0003	OVERALL PLOT PLAN	
6907-160-16-47-0402	LAYOUT OF FIRE WATER SYSTEM	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 1 of 7

PIPE CLASS : A1A
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT :

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343	371
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	9.84	8.78	7.73

SERVICE

NON CORROSIVE/ FLAMMABLE / NON FLAMMABLE/ NON LETHAL -PROCESS & HYDROCARBONS; AMMONIA, STEAM & CONDENSATE (NON IBR); UTILITIES- INST AIR(BEYOND A3A), PLANT AIR, NITROGEN, CARBONDIOXIDE, PURGE GAS, CARRIER GAS,FUEL GAS, FLUSHING OIL, SILANE, VENT TO ATMOSPHERE; WATER - BEYOND A3A AND A10A; IN OFFSITES ONLY BEYOND A10A, QUENCH OIL,CALCIUM HYDROXIDE(LIME).
DILUTION STEAM

NOTES

- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 -44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 73 GATE VALVES OF SIZE 26" AND ABOVE SHALL BE IN ACCORDANCE WITH BS-1414 AND FLANGE ENDS SHALL BE IN ACCORDANCE WITH ASME B16.47 SERIES B.
- 211 NDT REQUIREMENTS AS PER JOB SPECIFICATION 6907-6-44-0016

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

A1A

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 2 of 7

[illegible]

CODE	DESCRIPTION
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F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H. COUPLING	W	WELDOLETS		
P	PIPE TO PIPE	I	INSTRUMENT TEE		
R	REINFORCED	X	Refer Notes		
S	SOCKOLETS	L	SWEEPOLET		

A1A

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 3 of 7

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	16.00	36.00	STD	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	
PIP	PIPE	40.00	48.00	XS	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG/600	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	600, RF/125AARH	FSC0167Z0	
FLG	FLNG.WN	0.50	24.00	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z0	
FLG	FLNG.WN	26.00	48.00	M	B-16.47-B	ASTM A 105	150, RF/125AARH	FWB0127Z0	
FLG/150	FLNG.WN	0.50	10.00	M	B-16.5	ASTM A 105	150, RTJ/63AARH	FWC0129Z0	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLG/600	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	600, RF/125AARH	FWC0167Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26.00	48.00		B-16.47-B	ASTM A 105	150, RF/125AARH	FBB0127Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
FEF	SPCR&BLND	26.00	48.00		EIL'STD	ASTM A 516 GR.70	150, FF/125AARH	FCE6321Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 4 of 7

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
BND	PIPE.BEND	2.00	14.00	M	MNF'STD	ASTM A 234 GR.WPB	BW, 6D	WCN6846Z0	
BND	PIPE.BEND	16.00	24.00	M	MNF'STD	ASTM A 234 GR.WPB-W	BW, 5D	WCN7545Z0	
BND/1	PIPE.BEND	2.00	2.00	M	MNF'STD	ASTM A 234 GR.WPB	BW, 10D	WCN684EZ0	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 5 of 7

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
CAP	CAP	0.50	0.75		B-16.11	ASTM A 105	SCRF, 6000	WF60283Z0	
CAP	CAP	1.00	1.50		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	
CAP	CAP	2.00	48.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
UNN	UNION	0.50	0.75		BS-3799	ASTM A 105	SCRF, 6000	WQH0283Z0	
UNN	UNION	1.00	1.50		BS-3799	ASTM A 105	SCRF, 3000	WQH0282Z0	
Valves Group									
GAV	VLV.GATE	0.25	1.50		API-602	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51001	51001ZZZ0	
GAV	VLV.GATE	2.00	42.00		API-600	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51301	51301ZZZ0	
GLV	VLV.GLOBE	0.25	1.50		BS-5352	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52301	52301ZZZ0	
CHV	VLV.CHECK	0.25	1.50		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53301	53301ZZZ0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 6 of 7

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Valves Group									
BLV	VLV.BALL	0.50	16.00		BS-5351	BODY-ASTM A 105 / A 216GR.WCB,TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54301	54301ZZZ0	
BLV/1	VLV.BALL	0.50	16.00		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB,TRIM-SS 304+STELLITE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54394	54394ZZZ0	
PLV	VLV.PLUG	0.50	24.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB,TRIM-PLUG-HARDENED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 55301	55301ZZZ0	
PLV/1	VLV.PLUG	0.50	36.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB,TRIM-PLUG-HARDENED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 55315	55315ZZZ0	
BFV	VLV.BTRFLY	3.00	24.00		BS EN 593	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	WAF, 150, B-16.5, WAF/125AARH, SHT NO.- 56301	56301ZZZ0	
BFV	VLV.BTRFLY	26.00	48.00		BS EN 593	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.47 B, RF/125AARH, SHT NO.- 56315	56315ZZZ0	
NDV	VLV.NEEDLE	0.50	1.50		BS-5352	BODY-ASTM A 105,TRIM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 58092	58092ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	48.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 150	GK65072Z0	
GAS	GASKET	26.00	48.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK56272Z0	
GAS/150	GASKET	0.50	10.00		B-16.20-ANSI B16.5	SOFT IRON	OCT-RING, 150	GK67232Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 300	GK65074Z0	
GAS/600	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 600	GK65076Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105;T:13%CR;S:SS304	FLGD, THRMDNMC, 150,RF/125AARH	TR3065530	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A1A Sheet 7 of 7

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A516GR.70;INT:S304	CONETYPE, 150,FF/125AARH	ST16831Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	14.00	M	EIL'STD	B:A234GR.WPB;IN T:SS304	BW, T-TYPE	SP13344Z0	
PSR	STRNR.PERM	16.00	24.00	M	EIL'STD	B:A234GR.WPBW;I NT:SS304	BW, T-TYPE	SP13644Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 1 of 9

PIPE CLASS : A91A
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT :

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	0	38	50	65
PRESS	10.55	10.55	10.55	10.55

SERVICE

CATEGORY 'D' FLUID- COOLING WATER (A/G & U/G) ,RAW WATER (A/G &U/G)

NOTES

- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.
- 6 FOR FABRICATED REDUCERS,REFER EIL'STD 7-44-0485 & 7-44-0487. FOR MITRES, REFER EIL'STD 7-44-0033.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 64 AWWA C207 CL.D FLANGES SHALL BE OF HUB TYPE.
- 65 FORGINGS ARE ACCEPTABLE IN LIEU OF PLATE MATERIAL FOR BLIND FLANGES AND SPACER & BLINDS.
- 77 FOR SIZES > 24", SPACER & BLIND SHALL BE DESIGNED BY THE MANUFACTURER AS PER ASME B31.3.
- 86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.
- 106 FOR SIZES ABOVE 30", TEMPERATURE AND PRESSURE RATINGS SHALL BE 65 DEG.C & 7.5 KG/CM2G RESPECTIVELY.
- 107 USE 4-PIECE 90 DEG. MITRE FOR 8" & 10", 5-PIECE 90 DEG. MITRE FOR SIZES FROM 12" TO 44" AND 6-PIECE 90 DEGREE MITRE FOR SIZES 48" TO 80".(45 MITRE SHALL REQUIRE ONE PIECE LESS)
- 112 GASKET INNER RING MATERIAL SHALL BE SAME AS SPIRAL STRIP MATERIAL OF THE CLASS.
- 113 MODULUS OF SOIL REACTION = 800 T/SQM (IN CUTTING AREA 1.0 M TO 3.5 M), 1200 T/SQM (IN FILLING AREA)
- 114 BULK DENSITY OF SOIL = 1.50 T/CUM TO 2.0 T/CUM
- 115 ANGLE OF FRICTION OF FILL MATERIAL (EXCAVATED MATERIALS FROM TRENCH) WITH 90 % COMPACTION OF STANDARD PROCTOR DRY DENSITY) =29 DEG. (SILTY FINE SAND), K.u (mew)=0.18
- 116 BURIED PIPES SHALL BE TAPE COATED AS PER EIL SPECIFICATION 6-79-011.
- 206 FOR U/G SERVICES,PIPE WALL THICKNESSES ARE CALCULATED BASED ON SOIL PARAMETERS AND BURIAL DEPTH OF 1500 MM FOR SIZE UPTO 24",1000MM FOR 26"TO 40" AND 2000 MM FOR SIZE 42" &ABOVE.
- 211 NDT REQUIREMENTS AS PER JOB SPECIFICATION 6907-6-44-0016
- 212 FOR EXCHANGER PIPING,COOLING WATER SUPPLY SIDE SHALL BE GATE VALVE AND RETURN SIDE SHALL BE GLOBE VALVE FOR SIZES LESS THAN OR EQUAL TO 16".

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 2 of 9

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING 3000 LBS.	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD. 7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD 7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-353	
PRESS.CONN	0.75"	SW, SH HVY NIPPLE WITH GATE VALVE TO SPEC AS PER EIL STD 7-44-354	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 3 of 9

[illegible]

<u>CODE</u>	<u>DESCRIPTION</u>
F	SADDLE FUSED JT
T	TEES
J	THREADOLET
H	H. COUPLING
W	WELDOLETS
P	PIPE TO PIPE
I	INSTRUMENT TEE
R	REINFORCED
X	Refer Notes
S	SOCKOLETS
L	SWEEPOLET

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 4 of 9

			T	72.
		T	R	70.
T	R	R		68.
R	R	R		66.
R	R	R		64.
R	R	R		62.
R	R	R		60.
R	R	R		58.
R	R	R		56.
R	R	R		54.
R	R	R		52.
R	R	R		50.
R	R	R		48.
R	R	R		46.
R	R	R		44.
R	R	R		42.
R	R	R		40.
R	R	R		38.
R	R	R		36.
R	R	R		34.
R	R	R		32.
R	R	R		30.
R	R	R		28.
R	R	R		26.
R	R	R		24.
				22.
R	R	R		20.
R	R	R		18.
R	R	R		16.
R	R	R		14.
R	R	R		12.
R	R	R		10.
R	R	R		8.0
R	R	R		6.0
				5.0
R	R	R		4.0
				3.5
R	R	R		3.0
				2.5
R	R	R		2.0
H	H	H		1.5
				1.25
H	H	H		1.0
H	H	H		0.75
H	H	H		0.5
68.000				
70.000				
72.000				

BRANCH PIPE (SIZE IN INCHES)

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 5 of 9

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	1.50	HVY	IS-1239-I	IS-1239 (BLACK)	PE, C.WELDED	PI6D471Z0	
PIP	PIPE	2.00	6.00	HVY	IS-1239-I	IS-1239 (BLACK)	BE, C.WELDED	PI6D411Z0	
PIP	PIPE	8.00	12.00	6.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	14.00	18.00	8.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	20.00	24.00	10.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	26.00	30.00	12.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	32.00	40.00	12.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	106
PIP	PIPE	42.00	44.00	14.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	106
PIP	PIPE	46.00	56.00	16.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	106
PIP	PIPE	58.00	64.00	18.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	106
PIP	PIPE	66.00	72.00	19.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	
NIP	NIPPLE	0.50	1.50	HVY	IS-1239-I	IS-1239 (BLACK)	PBE, C.WELDED	PN6D461Z0	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	150, RF/125AARH	FSC0127Z0	
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG/300	FLNG.WN	26.00	40.00	M	B-16.47-B	ASTM A 105	300, RF/125AARH	FWB0147Z0	
FLG/600	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	600, RF/125AARH	FWC0167Z0	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLG	FLNG.SO	2.00	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FNC0127Z0	
FLG	FLNG.SO	26.00	72.00		AWWA-C207 CL.D	ASTM A 105	150, FF/125AARH	FN40121Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26.00	72.00		AWWA-C207 CL.D	ASTM A 285 GR.C	150, FF/125AARH	FB45321Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 6 of 9

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Flange Group									
FEF	SPCR&BLND	26.00	72.00		JOB'STD	ASTM A 285 GR.C	150, FF/125AARH	FCF5321Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	8.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	8.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
MIT90	MITRE.90	50.00	72.00	M	EIL'STD	IS-3589 GR.410	BW, 1.5D	WDKF241Z0	
MIT45	MITRE.45	50.00	72.00	M	EIL'STD	IS-3589 GR.410	BW, 1.5D	WGKF241Z0	
TEQ	T.EQUAL	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	8.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TEQ	T.EQUAL	50.00	72.00	M	MNF'STD	ASTM A 234 GR.WPB-W	BW	WEN754ZZ0	
TRED	T.RED	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	8.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
TRED	T.RED	50.00	72.00	M, M	MNF'STD	ASTM A 234 GR.WPB-W	BW	WRN754ZZ0	
REDC	REDUC.CONC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	8.00	30.00	M, M	EIL'STD	IS-3589 GR.330	BW	WUKF14ZZ0	
REDC	REDUC.CONC	32.00	72.00	M, M	EIL'STD	IS-3589 GR.410	BW	WUKF24ZZ0	
REDE	REDUC.ECC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	8.00	30.00	M, M	EIL'STD	IS-3589 GR.330	BW	WVKF14ZZ0	
REDE	REDUC.ECC	32.00	72.00	M, M	EIL'STD	IS-3589 GR.410	BW	WVKF24ZZ0	

Package : IPMCS

Report No. : 50

A91A

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 7 of 9

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
SWGC	SWAGE.CONC	0.50	3.00	STD, STD	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	STD, STD	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	0.50	1.50		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	
CAP	CAP	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	8.00	48.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	50.00	72.00	M	ASME-VIII	ASTM A 285 GR.C	BW	WF3J54ZZ0	
CPLF	CPLNG.FULL	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
UNN	UNION	0.50	1.50		BS-3799	ASTM A 105	SW, 3000	WQH02D2Z0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51001	51001ZZZ0	
GAV	VLV.GATE	2.00	24.00		API-600	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51321	51321ZZZ0	
GAV	VLV.GATE	26.00	80.00		BS-1414	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 51920	51920ZZZ0	
GLV	VLV.GLOBE	0.50	1.50		BS-5352	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52321	52321ZZZ0	
CHV	VLV.CHECK	0.25	1.50		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53321	53321ZZZ0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 8 of 9

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Valves Group									
CHV	VLV.CHECK	26.00	48.00		API-594	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 53316	53316ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS-5351	BODY-ASTM A 105 / A 216GR.WCB,TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54321	54321ZZZ0	7
BFV	VLV.BTRFLY	2.00	24.00		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	WAF, 150, B-16.5, WAF/125AARH, SHT NO.- 56321	56321ZZZ0	7
BFV	VLV.BTRFLY	26.00	56.00		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 56316	56316ZZZ0	
NDV	VLV.NEEDLE	0.50	1.50		BS-5352	BODY-ASTM A 105,TRIM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 58092	58092ZZZ0	
Bolt Group									
BOS	BOLT.STUD	18.00	72.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
BOM	BOLT.M/C	0.50	16.00		B-18.2	BOLT:A307 GR.B, NUT:A563 GR.B		BM41418Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.21-ANSI B16.5	NONASBESTOS BS7531 GR X	RING, 150, 2 MM	GKBAX52Z0	
GAS	GASKET	26.00	72.00		AWWA-C207 CL.D	NONASBESTOS BS7531 GR X	FULLFACE, 150, 2 MM	GK2AX22Z0	
GAS/300	GASKET	26.00	40.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL	SPIRAL, 300	GK55074Z0	
GAS/600	GASKET	2.00	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 600	GK65076Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 300	GK65074Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A285GR.C;INT:S S304	CONETYPE, 150,FF/125AARH	ST14431Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	6.00	M	EIL'STD	B:A234GR.WPB;IN T:SS304	BW, T-TYPE	SP13344Z0	
PSR	STRNR.PERM	8.00	24.00	M	EIL'STD	B:A234GR.WPBW;I NT:SS304	BW, T-TYPE	SP13644Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A91A Sheet 9 of 9

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Trap/Strainer Group									
PSR	STRNR.PERM	26.00	48.00	M	MNF'STD	B:A234GR.WPB;IN T:SS304	BW, T-TYPE	SP33344Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A96A Sheet 1 of 6

PIPE CLASS : A96A
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT :

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	-29	38	93	149	204	260
PRESS	15	15	15	15	14.06	11.95

SERVICE

U/G AND A/G OWS (PRESSURE PIPING),U/G OWS (GRAVITY PIPING),PALLET WATER DRAIN

NOTES

- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 73 GATE VALVES OF SIZE 26" AND ABOVE SHALL BE IN ACCORDANCE WITH BS-1414 AND FLANGE ENDS SHALL BE IN ACCORDANCE WITH ASME B16.47 SERIES B.
- 101 FOR U/G SERVICES, PIPE WALL THICKNESSES ARE CALCULATED BASED ON SOIL PERAMETERS AND BURIAL DEPTH OF 2500MM.
- 104 FOR PERMANENT AND TEMPORARY T-TYPE BW STRAINERS REFER EIL STD 7-44-0303 AND 7-44-0304
- 113 MODULUS OF SOIL REACTION = 800 T/SQM (IN CUTTING AREA 1.0 M TO 3.5 M), 1200 T/SQM (IN FILLING AREA)
- 114 BULK DENSITY OF SOIL = 1.50 T/CUM TO 2.0 T/CUM
- 115 ANGLE OF FRICTION OF FILL MATERIAL (EXCAVATED MATERIALS FROM TRENCH) WITH 90 % COMPACTION OF STANDARD PROCTOR DRY DENSITY) =29 DEG. (SILTY FINE SAND), K.u (mew)=0.18
- 208 FOR U/G SERVICES, PIPE WALL THICKNESSES ARE CALCULATED BASED ON SOIL PARAMETERS AND BURIAL DEPTH OF 3500 MM FOR 4" TO 24" AND1500 MM FOR LESS THAN 4".
- 211 NDT REQUIREMENTS AS PER JOB SPECIFICATION 6907-6-44-0016

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH GATE VALVE TO SPEC AS PER EIL STD 7-44-0354	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A96A Sheet 3 of 6

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	6.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	8.00	14.00	STD	B-36.10	API 5L GR.B PSL1	BE, WELDED	PI2E919Z0	
PIP	PIPE	16.00	20.00	STD	B-36.10	API 5L GR.B PSL1	BE, WELDED	PI2E919Z0	
PIP	PIPE	24.00	24.00	XS	B-36.10	API 5L GR.B PSL1	BE, WELDED	PI2E919Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	150, RF/125AARH	FSC0127Z0	
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z0	
FLG/600	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	600, RF/125AARH	FWC0167Z0	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A96A Sheet 4 of 6

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	0.50	0.75		B-16.11	ASTM A 105	SCRF, 6000	WF60283Z0	
CAP	CAP	1.00	1.50		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	
CAP	CAP	2.00	24.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A96A Sheet 5 of 6

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
Valves Group									
GAV	VLV.GATE	0.25	1.50		API-602	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51001	51001ZZZ0	
GAV	VLV.GATE	2.00	42.00		API-600	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51301	51301ZZZ0	
GLV	VLV.GLOBE	0.50	1.50		BS-5352	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52301	52301ZZZ0	
CHV	VLV.CHECK	0.25	1.50		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53301	53301ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS-5351	BODY-ASTM A 105 / A 216GR.WCB,TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54301	54301ZZZ0	
PLV	VLV.PLUG	0.50	24.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB,TRIM-PLUG-HARDENED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 55301	55301ZZZ0	
BFV	VLV.BTRFLY	3.00	24.00		BS EN 593	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	WAF, 150, B-16.5, WAF/125AARH, SHT NO.- 56301	56301ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A96A Sheet 6 of 6

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 150	GK65072Z0	
GAS/600	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 600	GK65076Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 300	GK65074Z0	
Trap/Strainer Group									
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	14.00	M	EIL'STD	B:A234GR.WPB;INT:SS304	BW, T-TYPE	SP13344Z0	104
PSR	STRNR.PERM	16.00	24.00	M	EIL'STD	B:A234GR.WPBW;INT:SS304	BW, T-TYPE	SP13644Z0	104

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A97A Sheet 1 of 5

PIPE CLASS : A97A
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT :

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	0	38	50	65	65
PRESS	15.4	15.4	15.4	15.4	18.2

SERVICE

FIRE WATER (ABOVE AND UNDER GROUND),FOAM SOLUTION (A/G &U/G)

NOTES

- 65 FORGINGS ARE ACCEPTABLE IN LIEU OF PLATE MATERIAL FOR BLIND FLANGES AND SPACER & BLINDS.
- 88 AS PER TAC REQUIREMENTS, 10% OF THE BUTT WELD JOINTS SHALL BE RADIOGRAPHED. HOWEVER, 50% OF THESE BUTT WELD JOINTS SHALL BE FIELD WELD JOINTS.
- 101 FOR U/G SERVICES, PIPE WALL THICKNESSES ARE CALCULATED BASED ON SOIL PERAMETERS AND BURIAL DEPTH OF 2500MM.
- 104 FOR PERMANENT AND TEMPORARY T-TYPE BW STRAINERS REFER EIL STD 7-44-0303 AND 7-44-0304
- 107 FOR SIZE ABOVE 24"SPACER AND BLIND AS PER EIL 'STD 7-44-0162
- 114 BULK DENSITY OF SOIL = 1.50 T/CUM TO 2.0 T/CUM
- 115 ANGLE OF FRICTION OF FILL MATERIAL (EXCAVATED MATERIALS FROM TRENCH) WITH 90 % COMPACTION OF STANDARD PROCTOR DRY DENSITY) =29 DEG. (SILTY FINE SAND), K.u (mew)=0.18
- 199 FOR U/G SERVICES, PIPE WALL THICKNESSES ARE CALCULATED BASED ON SOIL PARAMETERS AND BURIAL DEPTH OF 1500MM.
- 211 NDT REQUIREMENTS AS PER JOB SPECIFICATION 6907-6-44-0016

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING 3000 LBS.	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD. 7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD 7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-353	
PRESS.CONN	0.75"	SW NIPPLE WITH GATE VALVE TO SPEC AS PER EIL STD 7-44-354	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A97A Sheet 3 of 5

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	1.50	HVY	IS-1239-I	IS-1239 (BLACK)	PE, C.WELDED	PI6D471Z0	
PIP	PIPE	2.00	6.00	HVY	IS-1239-I	IS-1239 (BLACK)	BE, C.WELDED	PI6D411Z0	
PIP	PIPE	8.00	14.00	6.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	
PIP	PIPE	16.00	24.00	10.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	
PIP	PIPE	26.00	32.00	12.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	
PIP	PIPE	34.00	36.00	14.0	IS-3589	IS-3589 GR.410	BE, WELDED	PI7E319Z0	
NIP	NIPPLE	0.50	1.50	M	IS-1239-I	IS-1239 (BLACK)	PBE, SEAMLESS	PN6D467Z0	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	150, RF/125AARH	FSC0127Z0	
FLG	FLNG.WN	2.00	36.00	M	B-16.47-B	ASTM A 105	150, FF/125AARH	FWB0121Z0	
FLG	FLNG.SO	2.00	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FNC0127Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26.00	36.00		B-16.47-B	ASTM A 285 GR.C	150, FF/125AARH	FBB5321Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
FEF	SPCR&BLND	26.00	36.00		EIL'STD	ASTM A 285 GR.C	150, FF/125AARH	FCE5321Z0	107
Fitting Group									
ELB90	ELBOW.90	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	8.00	36.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	8.00	36.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
TEQ	T.EQUAL	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A97A Sheet 4 of 5

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
TEQ	T.EQUAL	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	8.00	36.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	8.00	36.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	8.00	36.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDE	REDUC.ECC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	8.00	36.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	STD, STD	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	STD, STD	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	0.50	1.50		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	
CAP	CAP	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	8.00	36.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
UNN	UNION	0.50	1.50		BS-3799	ASTM A 105	SW, 3000	WQH02D2Z0	
Valves Group									
GAV	VLV.GATE	0.25	1.50		API-602	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51001	51001ZZZ0	
GAV	VLV.GATE	2.00	42.00		API-600	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51301	51301ZZZ0	

Client : BCPL	Dept./Sect. : 16/43
Project : BPC-ASSAM	
Location : ASSAM	Pipe Class : A97A Sheet 5 of 5

Note : (The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Valves Group									
GLV	VLV.GLOBE	0.50	1.50		BS-5352	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52301	52301ZZZ0	
CHV	VLV.CHECK	0.25	1.50		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53301	53301ZZZ0	
BFV	VLV.BTRFLY	3.00	24.00		BS EN 593	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	WAF, 150, B-16.5, WAF/125AARH, SHT NO.- 56301	56301ZZZ0	
BFV	VLV.BTRFLY	26.00	48.00		BS EN 593	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.47 B, RF/125AARH, SHT NO.- 56315	56315ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	36.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.21-ANSI B16.5	NONASBESTOS BS7531 GR X	RING, 150, 2 MM	GKBAX52Z0	
GAS	GASKET	26.00	36.00		B-16.21-ANSI B16.47B	NONASBESTOS BS7531 GR X	FULLFACE, 150, 2 MM	GKAAX22Z0	
Trap/Strainer Group									
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	6.00	STD	EIL'STD	B:A234GR.WPB;IN T:SS304	BW, T-TYPE	SP13344Z0	104
PSR	STRNR.PERM	8.00	24.00	M	EIL'STD	B:A234GR.WPBW;I NT:SS304	BW, T-TYPE	SP13644Z0	104
PSR	STRNR.PERM	26.00	36.00	M	EIL'STD	B:A234GR.WPBW;I NT:SS304	BW, T-TYPE	SP13644Z0	104

JOB SPECIFICATION (Rotating Equipment)

SUPPLY OF DEWATERING PUMPS

PROJECT : BRAHMAPUTRA PETROCHEMICAL COMPLEX PROJECT

SITE : LAPETKATA

CLIENT : BRAHMAPUTRA CRACKER AND POLYMER LTD

CONSULTANT : ENGINEERS INDIA LTD

JOB NO. : 6907

A	20/08/2010	ISSUED WITH COMPOSITE WORKS TENDER	AS	SB	AKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

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1. SCOPE

This Specification alongwith attendant process datasheets, enclosed P&IDs etc. covers the minimum requirements to be followed during design, engineering, manufacture, inspection and testing, requirement of spares, scope for erection and commissioning of the following pumps as envisaged in Composite Works Tender for Railway Siding Terminal, Lapetkata of Brahmaputra Petrochemical Complex Project for M/s. BCPL :

- (a) Dewatering Pumps for Contaminated Rain Water Pit (Item No. : 160-P-01 A/B)
- (b) Dewatering Pumps for CRW/OWS Pit (Item No. : 160-P-02 A/B)

2. TECHNICAL REQUIREMENTS

Following technical requirements pertaining to the subject pump sets shall be met :

- 2.1. Pumps shall be single stage, horizontal centrifugal pumps conforming to Contractor's / Pump vendor's standard design.
- 2.2. Pumps shall be procured from EIL approved supplier list (attached herewith).
- 2.3. Pumps shall directly driven by electric motors. For details of electric motor, electrical portion of the tender shall be referred.
- 2.4. All electrical components & installations shall be suitable for the electrical area classification and grouping in which the equipment is installed.
- 2.5. Maximum allowable working pressure & temperature of the equipment shall not be less than the design pressure & temperature as specified in the data sheet.
- 2.6. Pump shut-off pressure including all tolerances with maximum suction pressure & maximum specific gravity shall not exceed downstream design pressure indicated in respective pump datasheets.
- 2.7. Pump rated flow shall not exceed 110% of best efficiency flow.
- 2.8. Electric Motor rating for the pumps shall be sized based on maximum of the following :
 - (a) 1.15 x BkW at rated duty point with rated impeller diameter
 - (b) BkW at end-of-curve operation
 - (c) BkW at minimum continuous flow with specific gravity = 1.0
- 2.9. Suction flange rating shall be same as that of discharge flange for all pumps.
- 2.10. No cast iron pressure containing parts shall be used for hydrocarbon service.
- 2.11. Inducers shall not be used for horizontal pumps.
- 2.12. Couplings
 - (a) Pumps shall be provided with spacer type couplings which shall be all metallic, non-lubricated Flexible element type (i.e. either Diaphragm coupling or Disc Coupling).
 - (b) Coupling shall be provided with non-sparking type coupling guard.
 - (c) All Coupling models shall be selected for a minimum service factor of 1.5.
 - (d) The spacer length of the coupling shall be adequate to permit removal of the coupling, bearings without disturbing the driver, pump rotor or suction/discharge Piping.
- 2.13. Material

Material of construction (MOC) of the pump parts shall be as per that given in the MR (wherever specified). Where the same has not been specified, the same shall be as per Contractor/pump vendor's standard MOC selection suitable for the specified service. Wherever the product handled contains corrosive components i.e. Sulphur, H₂S etc. the material of construction of the pump parts shall be suitable for Sour Service.
- 2.14. All auxiliary piping interface connections (such as drain and vent) shall be terminated with flanged valve at the equipment battery limit (i.e. at the edge of the base plate).
- 2.15. Pumps shall be unitized alongwith their drivers at respective equipment manufacturer's shop prior to dispatch. Pumps shall be supplied duly mounted on a single skid.

- 2.16. Pumps shall be packed for an outside storage period of six (6) months.
- 2.17. All pumps shall be suitable for outdoor installation. No equipment shelter is envisaged.
- 2.18. Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 88 dBA when measured at 1 (one) meter distance from the equipment skid in any direction. Acoustic hoods shall not be used for the above purpose.
- 2.19. Contractor / Pump Vendor shall include in his scope of supply initial fill of all lubricants & other consumables as required for erection and commissioning of the pump packages.

3. INSPECTION AND TESTS

- 3.1. Inspection and testing requirements of the pumps shall be as per contractor/ pump vendor's standard Inspection and Test plan. Necessary certificates of the same may be enclosed along with pump operating manual.

4. SPARES & SPECIAL TOOLS AND TACKLES

- 4.1. Contractor / Pump Vendor shall include in his scope of supply all commissioning spares (if any) as required for each of the pump packages.
- 4.2. Contractor / Pump Vendor shall also include in his scope of supply any special tools/tackle (if required during erection, commissioning and general maintenance for the pump packages).
- 4.3. Commissioning spares & special tools and tackles shall be procured along with the main equipment as per equipment manufacturer's recommendation.
- 4.4. Pump Vendor shall furnish during detail engineering his recommendation for two years normal operation and maintenance spares.

5. ERECTION AND COMMISSIONING

Complete erection and commissioning of the subject pump sets are in scope of Contractor. Contractor shall refer document entitled "Job Specification For Mechanical Erection & Pre-Commissioning Of Rotating Equipment" (Doc. No. : 6907-160-16-45-SP-0045 Rev. A) as enclosed along with the Tender for requirements pertaining to the erection and commissioning of the pumps.

6. DOCUMENTS REQUIRED AFTER ORDER

- 6.1. After award of contract, Contractor shall furnish the following drawings/documents pertaining to the subject pumps :
 - (a) Pump Mechanical Datasheet
 - (b) Pump Performance curves (Head v/s. Flow, NPSHR v/s. Flow, Power v/s. Flow)
 - (c) Electric Motor Datasheet
 - (d) General Assembly Drawing
 - (e) Cross Sectional Drawing
 - (f) List of spares (commissioning, 2 years normal operation and maintenance)
 - (g) List of Special Tools and Tackles (if any)
 - (h) Utility List (if any)
 - (i) Inspection and Test Plan/Reports/Records etc.
 - (j) Mechanical catalogue (containing all AS-BUILT documentation)
- 6.2. Pump Mechanical Datasheet may be submitted in Contractor / Pump vendor's standard format. However, the following minimum information shall be provided :
 - Pump Make / Model
 - Impeller diameter (maximum / rated / minimum)
 - Pump speed

- Power consumed @rated duty point, @Min. Continuous Flow with Sp. Gravity=1.0, @end-of-curve operation
- NPSH Required
- Nozzle details (sizes, rating, facing, finish, orientation) for Suction / Discharge main nozzles and auxiliary nozzles (such as casing drain, casing vent, baseplate drain etc.)
- Material of Construction of major pump components (such as pump casing, impeller, shaft, stuffing box, bearing housing etc.)
- Maximum Allowable Working Pressure @ Maximum Allowable Working Temperature

6.3. General Assembly Drawing shall contain as a minimum the following information :

- Outline dimensions (minimum three views) (all principal dimensions)
- Allowable forces and moments on suction and discharge nozzles
- Location (in all three planes), size, type, rating and identification of all Purchaser's interface connections including those of auxiliary connections (as applicable)
- Weight details of each assembly / component
- Maintenance clearances and dismantling clearances

6.4. Pump Performance Curve shall include as a minimum the following information :

- Maximum, minimum & rated diameters
- Pump Operating range
- Pump Minimum Continuous Flow
- Mark-up of rated duty point
- Eye area of the first stage impeller
- Identification number of the impeller
- Pump serial number

6.5. Only pump mechanical datasheet along with performance curves shall be submitted for approval by EIL. All other documents shall be submitted for information purposes only.

PROJECT		BPC PROJECT		CLIENT		M/S BCPL	
UNIT		RAILWAY SIDING NAPTHA UNLOADING		JOB NO		6907	
LOCATION		OWS/CRWS PIT INSIDE NAPTHA PUMP HOUSE					
ITEM NO	160-P-01A/B		SERVICE	CRW (CONTAMINATED RAIN WATER)			
NOS. OF PUMP	2 (1W + 1SB)		TYPE OF PUMP	HORIZONTAL CENTRIFUGAL PUMPS			
PROPERTIES OF LIQUID							
LIQUID HANDLED				OILY CONTAMINATED WATER			
PUMPING TEMPERATURE				DEG C		AMBIENT (35°C)	
VISCOSITY AT PUMPING TEMPERATURE				CS		0.715 CS	
VAPOUR PRESSURE AT PUMPING TEMPERATURE				kg/cm2 abs		0.06 Kg/cm2 abs	
LIQUID DENSITY AT PUMPING TEMPERATURE				Kg/m3		992	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				NO			
SOLIDS IN SUSPENSION				NO			
OPERATING CONDITIONS FOR ONE PUMP							
FLOW RATE		NORMAL	M3/HR	5			
		MAXIMUM	M3/HR	5			
		MINIMUM	M3/HR				
SUCTION PRESSURE			Kg/cm2 A	ATMOSPHERIC			
DISCHARGE PRESSURE			Kg/cm2 A	2.0			
DIFFERENTIAL PRESSURE			Kg/cm2	1			
DIFFERENTIAL HEAD			METRES	10 M			
NPSH AVAILABLE			METRES	>8.0 M			
CAPACITY CONTROL FOR PUMPS							
METHOD OF CONTROL				MANUAL			
TYPE OF CONTROL							
CONTROL RANGE							
PRECISION AT MINIMUM RATE							
MECHANICAL DATA							
DESIGN PRESSURE			Kg/cm2 G	16.00			
MAXIMUM SUCTION PRESSURE			Kg/cm2 G	1.0			
DESIGN TEMPERATURE			DEG C	65.0			
MATERIAL OF CONSTRUCTION							
CASING				KCS			
IMPELLER				KCS			
SHAFT				AISI 4140			
COLUMN PIPE				-----			
SEAL TYPE				PACKING			
LINE RATING				SUCTION 150#	DISCHARGE	150#	
DRIVER				ELECTRIC MOTOR			
STEAM TURBINE DATA				N.A.			
INLET PRESSURE			KG/CM2 G				
INLET TEMPERATURE			DEG C				
DESIGN PRESSURE			KG/CM2 G				
DESIGN TEMPERATURE			DEG C				
EXHAUST PRESSURE			KG/CM2 G				
LINE RATING				SUCTION	DISCHARGE		
NOTES:							
1. THE PUMP SHALL BE SUPPLIED WITH DRIVE.							
2. SUCTION & DISCHARGE MATCHING FLANGES ALONG WITH NUTS, BOLTS, GASKETS SHALL BE PROVIDED ALONG WITH PUMPS.							
3. SHUT OFF HEAD SHALL NOT EXCEED 120% OF RATED HEAD.							
4. REFER P&ID NO. 6907-04-41-160-1151							
160-P-01A/B							
		0	23.08.2010	ISSUED FOR ENGINEERING	P.B	G.G	A.K.G
		A	27.07.2010	ISSUED FOR COMMENTS	P.B	G.G	A.K.G
		NO	DATE	REVISION	BY	CHK	APP
 ENGINEERS INDIA LTD NEW DELHI		PUMP			PROCESS DATASHEET		REV
					6907-160-52-47-DSA1		0
					SHEET 1 OF 1		

PROJECT		BPC PROJECT		CLIENT		M/S BCPL	
UNIT		RAILWAY SIDING NAPTHA UNLOADING		JOB NO		6907	
LOCATION		OWS/CRWS COVERED SUMP					
ITEM NO	160-P-02A/B			SERVICE	OWS/CRWS		
NOS. OF PUMP	2 (1W + 1SB)			TYPE OF PUMP	HORIZONTAL CENTRIFUGAL PUMPS.		
PROPERTIES OF LIQUID							
LIQUID HANDLED				OILY CONTAMINATED WATER			
PUMPING TEMPERATURE				DEG C	AMBIENT(35°C)		
VISCOSITY AT PUMPING TEMPERATURE				CS	0.715 CS		
VAPOUR PRESSURE AT PUMPING TEMPERATURE				kg/cm2 abs	0.06 kg/cm2 abs		
LIQUID DENSITY AT PUMPING TEMPERATURE				Kg/m3	992		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				NO			
SOLIDS IN SUSPENSION				NO			
OPERATING CONDITIONS FOR ONE PUMP							
FLOW RATE		NORMAL	M3/HR	10			
		MAXIMUM	M3/HR	10			
		MINIMUM	M3/HR				
SUCTION PRESSURE		Kg/cm2 A		ATMOSPHERIC			
DISCHARGE PRESSURE		Kg/cm2 A		2.0			
DIFFERENTIAL PRESSURE		Kg/cm2 G		1			
DIFFERENTIAL HEAD		METRES		10 M			
NPSH AVAILABLE		METRES		>8.0 M			
CAPACITY CONTROL FOR PUMPS							
METHOD OF CONTROL				MANUAL			
TYPE OF CONTROL							
CONTROL RANGE							
PRECISION AT MINIMUM RATE							
MECHANICAL DATA							
DESIGN PRESSURE		Kg/cm2 G		16.00			
MAXIMUM SUCTION PRESSURE		Kg/cm2 G		1.0			
DESIGN TEMPERATURE		DEG C		65.0			
MATERIAL OF CONSTRUCTION							
CASING				KCS			
IMPELLER				KCS			
SHAFT				AISI 4140			
COLUMN PIPE				-----			
SEAL TYPE				PACKING			
LINE RATING				SUCTION 150#	DISCHARGE		150#
DRIVER				ELECTRIC MOTOR			
STEAM TURBINE DATA				N.A.			
INLET PRESSURE		KG/CM2 G					
INLET TEMPERATURE		DEG C					
DESIGN PRESSURE		KG/CM2 G					
DESIGN TEMPERATURE		DEG C					
EXHAUST PRESSURE		KG/CM2 G					
LINE RATING				SUCTION	DISCHARGE		
NOTES:							
1 THE PUMP SHALL BE SUPPLIED WITH DRIVE.							
2 SUCTION & DISCHARGE MATCHING FLANGES ALONG WITH NUTS, BOLTS, GASKETS SHALL BE PROVIDED ALONG WITH PUMPS.							
3 SHUT OFF HEAD SHALL NOT EXCEED 120% OF RATED HEAD.							
4 Refer P&ID No: 6907-160-16-47-3204							
160-P-02A/B							
		0	23.08.2010	ISSUED FOR ENGINEERING	P.B	G.G	A.K.G
		A	27.07.2010	ISSUED FOR COMMENTS	P.B	G.G	A.K.G
		NO	DATE	REVISION	BY	CHK	APP
 ENGINEERS INDIA LTD NEW DELHI		PUMP			PROCESS DATASHEET		REV
					6907-160-52-47-DSA2		0
					SHEET 1 OF 1		

List of Approved All Vendor for ROTATING EQUIPMENT Items

Parameter	Unit	Group Code	Range From	Range To	Remarks
Item : PUMP-CENT.HOR(GWS)(04AC)					
Vendor : BHARAT PUMPS & COMPRESSORS LTD(B006)					
Constraints :					
****		01	1.00	1.00	
Vendor : BEACON WEIR LIMITED(B018)					
Constraints :					
****		01	1.00	1.00	
Vendor : CLYDE UNION LIMITED (FRMLY T722 & W518)(C725)					
Constraints :					
****		01	1.00	1.00	
Vendor : DMW CORPORATION(D501)					
Constraints :					
****		01	1.00	1.00	
Vendor : EBARA CORPORATION (JAPAN)(E501)					
Constraints :					
****		01	1.00	1.00	
Vendor : FLOWMORE PRIVATE LIMITED(F127)					
Constraints :					
****		01	1.00	1.00	
Vendor : FLOWSERVE INDIA CONTROLS PVT LTD(F156)					
Constraints :					
****		01	1.00	1.00	Upto 250 KW-2P & 450 KW-4P: LR MODEL
Vendor : FLOWSERVE CORPORATION (FORMERLY I571)(F635)					
Constraints :					
****		01	1.00	1.00	
Vendor : GOULDS PUMPS INC(G510)					
Constraints :					
****		01	1.00	1.00	
Vendor : JYOTI LIMITED(J001)					
Constraints : 01A HOLIDAY (FINANCIAL CRISIS)					
****		01	1.00	1.00	
Vendor : KIRLOSKAR BROTHERS LTD(K003)					
Constraints :					
****		01	1.00	1.00	
Vendor : KSB PUMPS LTD (POONA)(K018)					
Constraints :					
****		01	1.00	1.00	
Vendor : KSB AKTIENGESSELSCHAFT(K501)					

List of Approved All Vendor for ROTATING EQUIPMENT Items

Parameter	Unit	Group Code	Range From	Range To	Remarks
Constraints :					
****		01	1.00	1.00	
Vendor : MATHER & PLATT PUMPS LTD.(M013)					
Constraints :					
****		01	1.00	1.00	
Vendor : NUOVO PIGNONE SPA (ITALY) (GE OILCO.)(N510)					
Constraints :					
****		01	1.00	1.00	
Vendor : RUHRPUMPEN GMBH(FORMERLY THYSSENT509)(R611)					
Constraints :					
****		01	1.00	1.00	
Vendor : SU MOTORS PVT LTD(S014)					
Constraints :					
****		01	1.00	1.00	
Vendor : SULZER PUMPS INDIA LIMITED(S401)					
Constraints :					
****		01	1.00	1.00	
Vendor : SULZER PUMPEN DEUTSCHLAND GMBH(S604)					
Constraints :					
****		01	1.00	1.00	
Vendor : STERLING FLUID SYSTEMS LIMITED(S610)					
Constraints :					
****		01	1.00	1.00	
Vendor : SHIN NIPPON MACHINERY CO LTD(S684)					
Constraints :					
****		01	1.00	1.00	
Vendor : SULZER PUMPS (US) INC(S744)					
Constraints :					
****		01	1.00	1.00	
Vendor : FLOWERVE(THOMPSONS KELLY&LEWIS PTY LTD)(T535)					
Constraints :					
****		01	1.00	1.00	
Vendor : WPIL LTD(W012)					
Constraints :					
****		01	1.00	1.00	Ghaziabad Works: Cap.with max.power rating of 500 KW & max.Head of 200m
Vendor : WEIR GABBIONETA(W600)					
Constraints :					
****		01	1.00	1.00	

JOB SPECIFICATION FOR SHOP & FIELD PAINTING FOR BCPL, ASSAM

0	17.12.07	ISSUED AS JOB SPECIFICATION BY SMMS DEPARTMENT	DR.DNW	GVS	G.V. SWAMY
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
SS	:	Stainless Steel
GI	:	Galvanized Iron
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
DM	:	De-mineralized
ID	:	Internal Diameter
OD	:	Outside Diameter
NB	:	Nominal Bore
RCC	:	Reinforced Cement Concrete
IRN	:	Inspection Release Note

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1.0 GENERAL

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

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

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

2.0 SCOPE

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

2.1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

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

- a. All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All uninsulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.
- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping

- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
 - i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
 - j. Over insulation surface of equipments and pipes wherever required.
 - k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
 - l. Painting of pre-erection/fabrication and Shop primer.
 - m. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.
 - n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.**
- 2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:
- a. Uninsulated austenitic stainless steel.
 - b. Plastic and/or plastic coated materials
 - c. Non-ferrous materials like aluminum.
- 2.3 **Documents**
- 2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.
- a. Bill of quantities for piping, equipment, machinery and structures etc.
 - b. Piping Line List.
 - c. Painting specifications including special civil defence requirements.
- 2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.
- 2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

- 3.1 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract.

IS-5	:	Colour coding.
RAL DUTCH	:	International Standard for colour shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels.
IS-2379	:	Indian Standard for Pipe line identification-colour code.
ASTM-Vol 6.01 & 6.03:		American standard test methods for Paints and Coatings.
ASA A 13.1-1981:		Scheme for identification of piping systems: American National Standards Institution.

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

- 3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.
- 3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).
- 3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).
- 3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.
- 3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.
- 3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:
- Instructions for storage to avoid exposure as well as extremes of temperature.
 - Surface preparation prior to painting shall be followed as per Table 8.0 to 16.0 of this specification shall be followed.
 - Mixing and thinning.
 - Application of paints and recommended limit on time intervals in between coats.

4.0 EQUIPMENT

- 4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data

sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

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

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

- 5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900(latest edition) or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish Standard in case of highly corrosive environment.

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

- 5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of Engineer-in-charge of OWNER/EIL
- 5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.
- 5.1.5 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush.

Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 Procedure of Surface Preparation :

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al_2O_3 particles, chilled cast iron or malleable iron and steel at pressure of $7kg/cm^2$ at a appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron . The combination of steel grits and shots shall be normally in the ratio of 3 : 1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

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

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- a. Hand de-scaling and/or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be bushed, swept, dusted and blow off with compressed

air/steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 Non-Compatible shop coat primer

The paint system followed for Shop coating of structures/equipments etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

- 5.4 Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.
- 5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.
- 5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7 Coating Procedure and Application

- 5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20KM per hour.
- 5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.
- 5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.
- 5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

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

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- h. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.
- j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- k. If spray gun shows choking, immediately de-choking procedure shall be followed.

- 5.7.7 Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

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

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

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

- a. Brushes shall be of a style and quality that will enable proper application of paint.
- b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paint shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be a minimum of brush marks left in the applied paint.
- f. Surfaces not accessible to brushes shall be painted by spray, doublers, or sheepskin.

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

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

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

5.8 Drying of coated surfaces

- 5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.
- 5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.
- 5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 Repair of damaged paint surface

- 5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.
- 5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection pre fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.10 Paint Application

- 5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)
- 5.10.2 Shop priming/ pre-erection priming with F9 or F12 shall be done only with airless spray.
- 5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.10.4 Assessment of painting requirement

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.

- Identify the design temperature from the technical documents
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.11 Documentation

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

TABLE-1 (FOR CLAUSE 5.0)

SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust, loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	profile.				for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

6.0 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, alongwith the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2, 6.3 and 6.4.

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	8-10μ	40-50μ	40-50μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	8-10	8-10	8-10	4m ² /kg
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs.	24 hrs.	24 hrs.	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C	NA	80°C	100°C.

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build finish paint.	High build coaltar epoxy coating.
2	Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: polyamide cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum.)	40%.	40%	62%	65%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	30-40μ	100-125μ	100-125μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre(minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C	1 hr.	30 minutes.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	16 hrs 5 days	8 hrs NA	16 hrs 5 days	48 hrs. 5 days
9	Over-coating interval at 30 °C	Min.: 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs.	Not applicable	4-6 hrs	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C	60 °C	80°C	125°C.

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%.	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125μ	65-75μ	20-25μ	20-25μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50% RH	Min.: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum.)	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (min)	80 °C	400 °C	250°C	500°C.

PAINT MATERIALS
TABLE No. 6.4 FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738 from Ameron Products, USA/ Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note: 6	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT (Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100 µm	125- 150 µm
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max. 5 days	Min. 36 hrs Max. 21 days	Min. 16 hrs Max. Not applicable	Min. 16 hrs Max. 21 days
10	Pot life at 30°C for two component paints (minimum.)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (min)	-45°C to 125°C under insulation	-45°C to 150°C under insulation (Note: 5)	Up to 400 deg. C for CS & SS surfaces under insulation	-45°C to 150°C for immersion service

NOTES (for tables 6.1 to 6.4):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through SMMS.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. F-15: Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.
6. F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

‘Amercoat 738’ from Ameron Products USA/Kansai Nerolac Paints Ltd. Mumbai, suitable upto 400°C for CS surfaces and 600°C for SS surfaces.

‘Berger 938’ from Berger Paints Ltd Kolkata, suitable upto 400°C for CS & SS surfaces.

‘Intertherm 751’ from Akzo Nobel Coatings and Sealants Pvt Ltd, Bangalore, Inorganic co-polymer cold applied Aluminium spray coating suitable upto 400°C of CS & SS surfaces.

6.5 List of recommended Manufactures

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

7.0 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area, Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSIFICATION

- **Corrosive Environment-Offsite areas** (excluding Cooling Tower area, DM-plant)
- **Corrosive Environment-Unit areas**
- **Highly Corrosive Environment-Unit & Offsite areas** of a plant with corrosive fumes like HCL, H₂SO₄, Water impingement, Salty water, Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes:

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 16.0.
2. Primers & Finish paints covered in Tables 8.0 to 16.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 7.2.

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0 - 16.0

<u>PRIMERS</u>	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based `ZINGA` zinc primer containing 96% of electrolytic zinc dust in dry film.
<u>FINISH COATS/PAINTS</u>	
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with polyamine hardner
F-6B	High Build Epoxy finish coating cured with polyamide hardner
F-7	High build Coal Tar epoxy coating cured with polyamine hardner
F-8	Self priming surface Tolerant High Build epoxy coating, cured with polyamine hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint.
F-14	Specially formulated coaltar epoxy coating, cured with polyamine hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

**TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING
AFTER ERECTION/WELDING** for all insulated and un-insulated CS, LTCS & low
allow steel items in all environments. (refer clauses 5.4, 5.5 & 5.9)

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40µ DFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.3	401 to 550	SSPC-SP-3	1 coat of F-12	20	-DO-

NOTES:

- 1 The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advise re-blasting and priming again if required.
- 2 The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

TABLE 8.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFFSITE AREAS (excluding Cooling Tower area & DM Plant area) for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
8.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
8.2	-14 to 60	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-2 @ 40 μ DFT/coat	2 coats of F-3 @ 40 μ DFT/coat ; (2x40=80)	185	
8.3	61 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245	F-3 paint shall contain pure chlorinated rubber, not modified.
8.4	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	3 coats of F-11 @ 20 μ DFT/coat; (3x20=60)	125	F-12 shall be ambient temperature curing type
8.5	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	Flare lines shall be painted as per Table 9.0.
8.6	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40)	60	

NOTES

- The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.
- For external surfaces of RCC chimney: 2 coats of F-6 @ 100 μ DFT/coat to obtain 2x100=200 μ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.
- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2
- In case of Paint systems as per Sl Nos 8.5 and 8.6, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 18.0.

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS
for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
9.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @65-75µDFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/coat	1 coat of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (100+40=140)	245-255	
9.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40) or 1 coat of F-16 @50 µ DFT/coat.	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per Sl Nos 9.3 and 9.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCL, H₂SO₄, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipments, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc(Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
10.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
10.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	2 coat of F-6A @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (2x100+40=240)	345-255	
10.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat 2x20=40 or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	
10.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat; (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per Sl Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

**TABLE 11.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (EXTERNAL)
All areas (Units & Offsites)**

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
11.1	All external surfaces of shell, internal surfaces of shell above maximum liquid level exposed to atmosphere, wind girders, appurtenances, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasolene, motor spirit, DM water, firewater, raw water, potable water, acids, alkalis, solvents and chemicals etc.					
11.1.1	-14 to 80	SSPC-SP-10;	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 coats of F-6A @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat; (2x100+40=240)	345-355	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat; (80+40=120)	280	
11.1.3	151TO 500	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	2 coats of F-12 @ 20µ DFT/coat; (2x20=40) or 1 coat of F-16 @ 50µ DFT/coat	105-115 OR 115-125	F-12 shall be ambient temperature curing type
11.2	External surfaces of bottom plate (soil side) for all storage tanks.					
11.2.1	-14 TO 80	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
11.2.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	

NOTES

- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

**TABLE 12.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (INTERNAL)**
All Areas (Units & Offsites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 1meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing crude oil, LDO, HSD and Gas Oil (Excluding white oil products)					
12.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 Coats of F-6A @ 100µ DFT/coat; (2x100=200)	305-315	Note-2
12.2	Inside of bare shell of floating roof tanks and cone roof tanks for items mentioned in 12.1					
12.2.1	-14 TO 80	SSPC-SP-10	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	2 coats	DFT need not be measured reconciliation of Chemical used shall be done (Note : 4)
12.3	Floating / Cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, bottom course upto 4 meters height inside shell, underside of floating roof and shell above maximum liquid level, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
12.3.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @ 100µ DFT/ coat; (3x100=300)	365-375	Note-2
12.4	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.3.					
12.4.1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	
12.5	Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.					
12.5.1	-14 to 80	SSPC-SP-10	2 Coats of P-6 @ 40µ DFT/coat; (2x40=80)	2 Coats of F-6B @ 100µ DFT/ Coat; (2x100=200)	280	Note-2
12.6	D.M. (De-mineralized water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories					
12.6.1	-14 to 60	SSPC-SP-10	None	Natural Rubber lining as per SMMS specifications 6-06-204	4.5MM	For DM tanks without steam blanketing
12.6.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	For DM tanks with steam blanketing
12.7	EG(Ethylene Glycol) tanks (internal shell, bottom plate roof and all accessories)					
12.7.1	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer Amercoat 23 @ 75µ /Coat ; (3x75=225)	225	

12.8	Inside pontoon and inside of double deck of all floating roofs.					
12.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	
12.9	Internal surfaces of wet slop, amine, sour water, water draw off storage tanks					
12.9.1	-14 TO 80	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat; (80+80=160)	240	
12.10	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 4meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing Vacuum Residue, Fuel oil, dry slop and other high temperature hydrocarbon liquids.					
12.10.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	Note:3
12.11	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.10					
12.11.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	None	125	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
2. F-6A/F6B should be suitable for immersion service of the products given.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is upto 200°C. Cases of operating temperature > 150°C **are not covered in this spec, such cases shall be covered in the job specifications.**
4. The phosphating chemical shall be applied on blast cleaned surface inside the shell of carbon steel storage tanks at the time of erection. Incase, any corrosion is observed at the time of commissioning, 2 coats of the phosphating chemical shall be applied at the discretion of Engineer-in-charge.

TABLE 13.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND TANKS IN ALL AREAS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Underground carbon steel plant piping (Yard/ Over the Ditch Corrosion protection Coating)					
13.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25 @μ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @μ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Spec.No 6-79-0011	4 mm	
13.2	Carbon steel plant piping (underground).					
13.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	
13.3	External side of un-insulated underground storage tanks:					
13.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	
13.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	

TABLE 14.0 PAINTING UNDER INSULATION (ALL ENVIRONMENTS)
All areas (Units & Offsites) for insulated Piping, Storage Tanks, Equipments etc
(Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Insulated carbon steel, LTCS and low allow steel Piping, Storage Tanks, Equipment etc					
14.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-14 @ 125µ DFT/coat; (2x125=250) or 3 coats of F-15 @ 80µ DFT/coat ; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking.
14.1.2	126-400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 @ 20µ DFT/coat; (3x20=60) or 1 coat F-16 @ 60 µ DFT/coat	125 – 135	F-12 shall be ambient temperature curing type
14.2	Insulated stainless steel including Alloy-20 piping (Note:2)					
14.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 coats of F-14 @ 125µ DFT/coat;	250	
	0 to 125 (alternate)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15@ 80µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
14.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16@ 125 µ DFT/coat	None	1 coat of F-16@ 125 µ DFT/coat	250	
14.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for the temperature of 600 deg.C and cyclic temperature.
14.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP-10 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	
14.3	No painting is required for insulated monel, incoloy and nickel lines.					

NOTES

1. Refer Notes 1 & 4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to 125 deg.C, both 14.2.1 & 14.2.2 are applicable.

TABLE 15.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS / CONDENSERS
 Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Upto 65	SSPC-SP-10; 1 coat of P-6 @ 40μ DFT/coat	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	290	For CS surfaces
15.2	Upto 65	SSPC-SP-3; 1 coat of P-4 @8-10μ DFT/ coat+ 1coat of P- 6 @ 40μ DFT/coat.	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 16.0 PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
16.1	Upto 65	SSPS-SP-3	1 coat of P-4 @8-10μ DFT/ coat + 1 coat of P-6 @ 40μ DFT/coat	2 coats of F-2 @ 40μ DFT/coat; (2x40=80)	130	Shade as per defence requirements
16.2	Upto 65	SSPS-SP-3	1 coat of P-4 @ 8μ DFT/coat.+ 1 coat of P-6 @ 40μ DFT/coat.	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

17.0 STORAGE

- 17.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word “PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE” shall be clearly displayed outside. Manufacturer’s recommendation shall be followed for storage of paint materials.

18.0 PIPING COLOUR CODE:

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

18.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

- 18.1.1 The following ground colour designation for identification of basic classification of various important services shall be followed:

Post Office Red	-	Fire protection materials
Off White/Aluminium	-	Steam (all pressures)
Canary Yellow	-	Chemicals and dangerous materials
Dark Admiralty Grey	-	Crude oil, lube oil
Orange	-	Volatile petroleum products (motor spirit and lighter)
Oxide red	-	Non-volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	-	Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	-	Water (all purities and temperatures)
Sea green	-	Air and its components and Freon

- 18.1.2 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

18.2 COLOUR BANDS AND IDENTIFICATION LETTERING

- 18.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black

letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm wide and regardless of band width, are spaced 25 mm apart when two bands are employed

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel	:	150 mm (Height)
Pump, compressor and other machinery	:	50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

18.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

18.2.3 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

18.2.4 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

18.2.5 Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

18.2.6 Colour band specification:

- a) Unit Area: Bands at intervals of 6.0 meters.
- Offsite Area: Bands at intervals of 10.0 meters.

- b) Each pipe segment will have minimum one band indication, irrespective of length.
- c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.
- 18.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½" wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.
- 18.4 In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.
- 18.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

RECOMMENDED RAL COLOUR CODE FOR PAINTING OF PIPING AND EQUIPMENT

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE			
			BASE COLOUR		BAND COLOUR	
HYDROCARBON LINES (UNINSULATED)						
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012		2011	
2	CRUDE SWEET	Dark Admiralty grey with 1 red band	7012		3001	
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012		6010	
4	FLARE LINES	Heat Resistant Aluminium	9006			
5	LPG	Orange with 1 oxide red band	2011		3009	
6	PROPYLENE	Orange with 2 blue bands	2011		5013	
7	NAPHTHA	Orange with 1 green band	2011		6010	
8	M.S.	Orange with 1 dark admiralty grey band	2011		7012	
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011	6010	9010	3001
10	GASOLINE (regular, leaded)	Orange with 1 black band	2011		9005	
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011		5013	
12	GASOLINE (white)	Orange with 1 white band	2011		9010	
13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011		3001	
14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011		4006	
15	N-PENTANE	Orange with 2 blue bands	2011		5013	

16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
25	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Black with 1 orange band	9005	2011
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
CHEMICAL LINES				
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000
41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013
48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031

WATER LINES				
51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 yellow bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
FIRE PROTECTION SYSTEM (ABOVE GROUND)				
63	FIRE WATER FOAM & EXTINGUISHERS	Post office red	3002	
AIR & OTHER GAS LINES (UNINSULATED)				
64	SERVICE AIR	Sea green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Sea green with 1 black band	6018	9005
66	NITROGEN	Sea green with 1 orange band	6018	2011
67	FREON	Sea green with 1 yellow band	6018	1023
68	CHLORINE	Canary yellow with 1 oxide band	1012	3009
69	SO ₂	Canary yellow with 2 white bands	1012	9010
70	H ₂ S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021
STEAM AND CONDENSATE LINES (UNINSULATED)				
75	HP STEAM	Off white / Aluminum with 1 yellow band	9006	1023
76	MP STEAM	Off white / Aluminum with 1 red band	9006	3001
77	MLP STEAM	Off white / Aluminum with 1 orange band	9006	2011
78	LP STEAM	Off white / Aluminum with 1 light green band	9006	6021

79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 red bands	5015	3001
Note: For all insulated steam lines, the colour coding shall be follow as given for un-insulated lines with the specified length of color bands.				
INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	1Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001
86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013
90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001
93	CRUDE OUR	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Steel grey	7011	
97	HEATER CASING	Heat resistant aluminium	9006	
98	VESSELS & COLUMNS	Aluminium	9006	
99	HYDROGEN BULLETS	Pink	3014	
100	LPG VESSELS	Oxide red	3009	
101	SO ₂ VESSEL	Canary yellow	1012	
102	HEAT EXCHANGER	Heat resistant aluminium	9006	
103	FO TANK AND HOT TANKS	Black	9005	
104	ALL OTHER TANKS	Aluminum / Off white	9006	

105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004
106	SOUR WATER	Sky Blue	5015
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006
108	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012
109	PUMPS	Navy blue	5014
110	MOTORS & SWITCH GEAR	Bluish green	5024
111	HAND RAILING	Signal red	3001
112	STAIRCASE, LADDER AND WALKWAYS	Black	9005
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
114	GENERAL STRUCTURE	Black	9005
PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
115	IBR	Signal red	3001
116	9Cr-1Mo	Verdigris green	6021
117	5Cr-0.5Mo	Satin blue	5012
118	2 $\frac{1}{4}$ Cr-1 Mo	Aircraft yellow	1026
119	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	Traffic Yellow	1023
120	SS-304	Dark blue grey	5008
121	SS-316	Dark violet	4005
122	SS-321	Navy blue	5014
SAFETY COLOUR SCHEMES			
123	DANGEROUS OBSTRUCTION	Black and alert orange band	9005 2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008

19.0 IDENTIFICATION OF VESSELS, PIPING ETC.

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

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

19.2 Identification of storage tanks:

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

20.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

- 20.1 Following items shall be painted for camouflaging if required by the client.
- All Columns
 - All tanks in Offsites
 - Large Vessels
 - Spheres
- 20.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.
- 20.3 **Method of Camouflaging**
- 20.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).
- | | | |
|------------|-------------|-------------------|
| Dark Green | Light Green | Dark Medium Brown |
| 5: | 3: | 2 |
- 20.3.2 The patches should be asymmetrical and irregular.
- 20.3.3 The patches should be inclined at 30° to 60° to the horizontal.
- 20.3.3 The patches should be continuous where two surfaces meet at an angle.
- 20.3.4 The patches should not coincide with corners.
- 20.3.5 Slits and holes shall be painted in dark shades.
- 20.3.6 Width of patches should be 1 to 2 meters.

21.0 INSPECTION AND TESTING

- 21.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.
- 21.2 Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.
- The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.
- 21.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

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

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

21.4 **Primer Application**

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

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

- 21.6 The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

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

- 21.8 At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

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

- 21.10 The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

22.0 GUARANTEE

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

23.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor who is awarded any job for EIL, Projects under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

24.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

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

- 24.1 The manufacturer should arrange testing of the coating materials as per the list of tests given in para 24.4 below from one of the reputed Government laboratories.
- 24.2 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.
- 24.3 All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed alongwith test report.

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

IICT, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
UICT, Matunga, Mumbai
RITES, Kolkata
PDIL, Sindri
NTH, Kolkata

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

Test required for evaluation of acceptance of coating materials for onshore application.

<u>Test</u>	<u>ASTM Test Method</u>
Density	D 1475
Dipping properties	D 823
Film characteristics	
Drying time	D 1640
Flexibility	D 1737/D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt spray 2000 hrs	B 117
Accelerated Weathering	D 822
% Zn in Dry film for Inorganic Zinc	G 53
Silicate primer	

24.5 Coating systems for panel test shall be decided after discussion with EIL.

24.6 Clause No. 24.0 is for approval prior to award of the contract. In case any agency proposes for any fresh approval after award of work, the same shall have no time implications upon the contract.

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS

Indian Vendors

1. Asian Paints (I) Ltd., Mumbai
2. Berger paints Ltd., Kolkata
3. Kansai Nerolac Paints Ltd., Mumbai (including Ameron, USA Products).
4. Chugoku Marine Paints Pvt. Ltd., Mumbai
5. Shalimar Paints Ltd., Kolkata
6. Sigma Kalon Marine and Protective Coatings(India) Pvt Ltd, Mumbai.
7. CDC Carboline Ltd., Chennai
8. Premier products Ltd., Mumbai
9. Coromandel Paints & Chemicals Ltd., Visakhapatnam
10. Anupam Enterprises, Kolkata
11. Grand Polycoats, Vadodara
12. Bombay Paints Ltd., Mumbai
13. Akzo Nobel Coatings and Sealants Pvt. Ltd., Bangalore
14. Cipy Polyurethanes Pvt. Ltd., Pune
15. Gunjan Paints Ltd., Ahmedabad
16. Advance Paints Ltd., Mumbai
17. VCM Polyurethane Paints (for polyurethane paints only)
18. Jotun Paints India Pvt Ltd, Chennai(Singapore)
19. Paladin Paints and Chemicals , Mumbai
20. Chembond Chemicals Pvt Ltd , Navi Mumbai
21. Aashish Coating Technologies Pvt. Ltd, Vadodara/Mumbai

Foreign Vendors

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

The following are approved for specific materials only.

- 1.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only).
- 2.0 ChemTreat India Ltd.(for Phosphating Chemical and glass flake filled coatings of M/s Atlas Chemicals Corporation, USA).
- 3.0 Carolina equipment and supply Co., USA.
- 4.0 Zinga Metall(Rozenstraat 4-Industrial Zone)-9810 EKE-Belgium, Indian Agent-Newkem, Mumbai-14 (for cold spray zinc coating)

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURERS' PRODUCTS

Sl. No	Manufacturers Name	P2 Chlorinated Rubber Zinc Ph Primer	P4 Etch Primer/ Wash Primer	P6 Epoxy Zinc Ph. Primer	F9 Inorganic Zinc Silicate Primer/ Coating
1	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH.PRIMER RO PC 168	APCONYL WP636 (PC335)	APCODUR HB.ZP. PC433	APCOSIL 605
2	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610 HB PRIMER	ZINC ANODE 304 MZS
3	AMERON PRODUCTS	-	AMERCOAT 178	AMERCOAT 71/385P	DIMETCOTE-9FT
4	CHEMBOND CHEMICALS	KEMCHLOR 201	KEMGALVA GRIP A1	KEMOXY 301	KEMGUARD 501
5	SHALIMAR PAINTS LTD	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILIKATE
6	SIGMA KALON INDIA PVT LTD,	SIGMA NUCOL UNICOAT 7321	SIGMA ETCH PRIMER (7185)	SIGMA COVER 256 (7412)	SIGMAZINC- 158
7	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8	PREMIER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB.ZN.PH PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN.PH. HIGH BILD PRIMER	CPC INORGANIC ZINC SILICATE PRIMER
10	ANUPAM ENTERPRISES	ANUHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	ANUZINC 2001 TP
11	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401	-	GP PRIME 402
12	BOMBAY PAINTS LTD.	PENTA CHLOR HB PRIMER 8632	PENTOLITE WASH PRIMER 8520	PENTADUR PRIMER 8530	ZINC-O-SIL 75
13	HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	-	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
14	AASHISH COATING TECH-NOLOGIES				
15	AKZO NOBEL PAINTS	-	-	INTERGARD 251	INTERZINC 12/22
16	PALADIN PAINTS	VEGCHLOR HB PRIMER 1143	VEGWASH PRIMER 1181	VEGPOX 1241ZP	THERMOSIL1362 ZINC
17	VCM POLYURETHANE PAINTS				
18	JOTUN PAINTS		JOTA ETCH TWO PACK WASH PRIMER	EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	RESIST-86
19	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	CHUGOKU MARINE PAINTS PVT. LTD.	-	-	CAMIDECK PRIMER	GALBONS HB
21.	KANSAI NEROLAC PAINTS LTD.	NEROLAC HB CR ZINC PHOSPHATE PRIMER	NEROLAC ETCH PRIMER	NEROLAC EPOXY ZINC PHOSPHATE PRIMER	NEROSIL 118

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (Cont. ...)

Sl. No	Manufacturers Name	F2 Acrylic-Polyurethane Finish Paint	F3 Chlorinated Rubber Finish Paint	F6A/B High Build Epoxy Finish Paint	F7 High Build Coal Tar Epoxy Coating
1	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 319)	APCODUR HB COATING PC 1262	APCODUR CF 651/655(PC 131/471)
2	BERGER PAINTS LTD.	BERGER ACRYLIC PU FINISH	LINOSOL CHLORINATED RUBBER HB COATING	EPLIUX 04 AND 78 HB EPOXY COATING	EPILUX 555
3	AMERON	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
4	CHEMBOND CHEMICALS	KEMTHANE 411	KEMCHLOR 211	KEMOXY 324	KEMOXY 314
5	SHALIMAR PAINTS LTD	SHALITHANE FINISH	CHLORKOTE HB FINISH	EPIGARD TL FINISH POLYAMINE/ POLYAMIDE	BIPIGARD CTE ZL BLACK HB COAL TAR EPOXY COATING
6	SIGMA COATINGS.	SIGMADUR GLOSS (7528)	SIGMA NUCOL FINISH 7308	SIGMA GUARD 720	SIGMACOVER 300 (7472)
7	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBO-MASTIC-14
8	PREMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350/3A, COAL TAR EPOXY COATING
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROTHANE SUPER PU FINISH	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11	GRAND POLYCOATS	GP BOND 141	GP CHLOROGAURD 631	GP GUARD HP234	POLYGUARD CE
12	BOMBAY PAINTS LTD.	PENTATHANE FP 4510	PENTACHLOR FB 4635	PENTADUR HB 5540/5520	PENTADUR COALTAR EPOXY 8518/6518
13.	HEMPEL MARINE PAINTS	-	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
14.	AASHISH COATING TECH	GA 1110 PU-UB		GA701 HB	
15	AKZO NOBEL COAITNGS	INTERTHANE 990	-	INTERGARD 966 / 410	INTERTUF 262 (TAR FREE TYPE)
16	PALADIN PAINTS	VEGTHANE (ALIPHATIC)	VEGCHLOR FP3140	VEGEPOX 3245/3562	VEGEPOX 4265
17	VCM POLYURETHANE PAINTS	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18	JOTUN PAINTS	HARDTOP XP		PENGUARD HB	JOTAGUARD 85
19	KCC PRODUCTS (KOREA)			KOEPOX TOPCOAT HB ET 5740	EH 173
20.	CHUKOGU MARINE PAINTS PVT LTD.	UNY MARINE	-	EPICON MARINE FINISH HB	BISCON HB 2001/ACHB
21.	KANSAI NEROLAC PAINTS	NEROTHANE ENAMEL	NEROLAC HB CHLORINATED RUBBER ENAMEL	NEROPOXY HB 262/6061	NEROLAC EPOXY COAL TAR POLYAMINE/POLY AMIDE CURED.

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (cont. ...)

Sl. No.	Manufacturers Name	F8 Epoxy Mastic Coating Surface Tolerant	F-11 Heat Resistant Synthetic Medium Aluminium Paint	F-12 Heat Resistant Silicone Aluminium Paint	F-15 Two Pack Ambient Temperature Curing Epoxy Phenolic Coating
1	ASIAN PAINTS (I) LTD.	APCODOR CF 640	ASIAN HR ALUMINIUM PAINT (PC 300)	HR SILICONE ALUMINIUM PAINT (PC 189)	
2	BERGER PAINTS LTD.	PROTECTO MASTIC	FERROTOL HR ALUMINIUM PAINT	LUMEROS HR SILICONE AL. PAINT(HR/143)	BERGER EPOXY PHENOLIC COATING
3	AMERON	AMERLOCK 400		AMERCOAT 878	
4	CHEMBOND CHEMICALS	KEMGUARD 555	KEMGUARD 250HR	-	-
5	SHALIMAR PAINTS LTD	EPIPLUS 556	HEAT RESISTING LUSTROL ALUMINIUM	LUSTOTHERM HS SILICONE ALUMINIUM	EPIGARD TL 543 HS FINISH
6	SIGMA COATINGS.	SIGMA COVER 630 (7428)	HIGH TEMPERATURE RESISTANT EPOXY SYSTEM UPTO 200°C	SIGMATHERM 540/SUPER THERMOVIT 600	SIGMA PHENGUARD 930 SYSTEM
7	CDC CARBOLINE LTD.	CARBO MASTIC-15	CARBOLINE 1248	CARBOLINE 4674	
8	PREMIER PRODUCTS LTD.	BH EPOXY MASTIC 150B/150A			
9	CORAMANDEL PAINTS & CHEMICALS LTD.	-	SILVOTOL HR ALUMINIUM PAINT	CPC SILICONE HR ALUMINIUM PAINT	
10	ANUPAM ENTERPRISES	ANU-MASTIC-102	-	ANUPAM HEAT GUARD.	
11	GRAND POLYCOATS	GP PRIME GUARD 235	-	-	
12	BOMBAY PAINTS LTD.	PENTADUR MASTIC 5515	KANGAROO HHR ALUMINIUM 4950	PENTHOLITE HRR ALUMINIUM 4951	
13.	HEMPEL MARINE PAINTS	HEMPDUR 1708			
14	AASHISH COATING TECH	GA700SPE	-	-	-
15	AKZO NOBEL COATINGS	INTERSEAL 670HS	INTERTHERM 891	INTERTHERM 50	INTERTHERM 228
16	PALADIN PAINTS	VEGEPOX MASTIC 2285	VEG HR AL PAINT	VEG HHR AL PAINT 600 DEG C	
17	VCM POLYURETHANE PAINTS	-	-	-	-
18	JOTUN PAINTS	PRIMASTIC UNIVERSAL	JOTUN AL PAINT HR 250 DEG.C	SOLVELITT AL SILICONE PAINT	TANKGUARD STORAGE
19	KCC PRODUCTS (KOREA)	EH 4158H		QT 606	
20.	CHUKOGU J&N LTD.	UMEGUARD MT/SX			
21.	KANSAI NEROLAC PAINTS LTD.	NEROMASTIC 400	NEROTHERM 250	NEROTHERM 538	

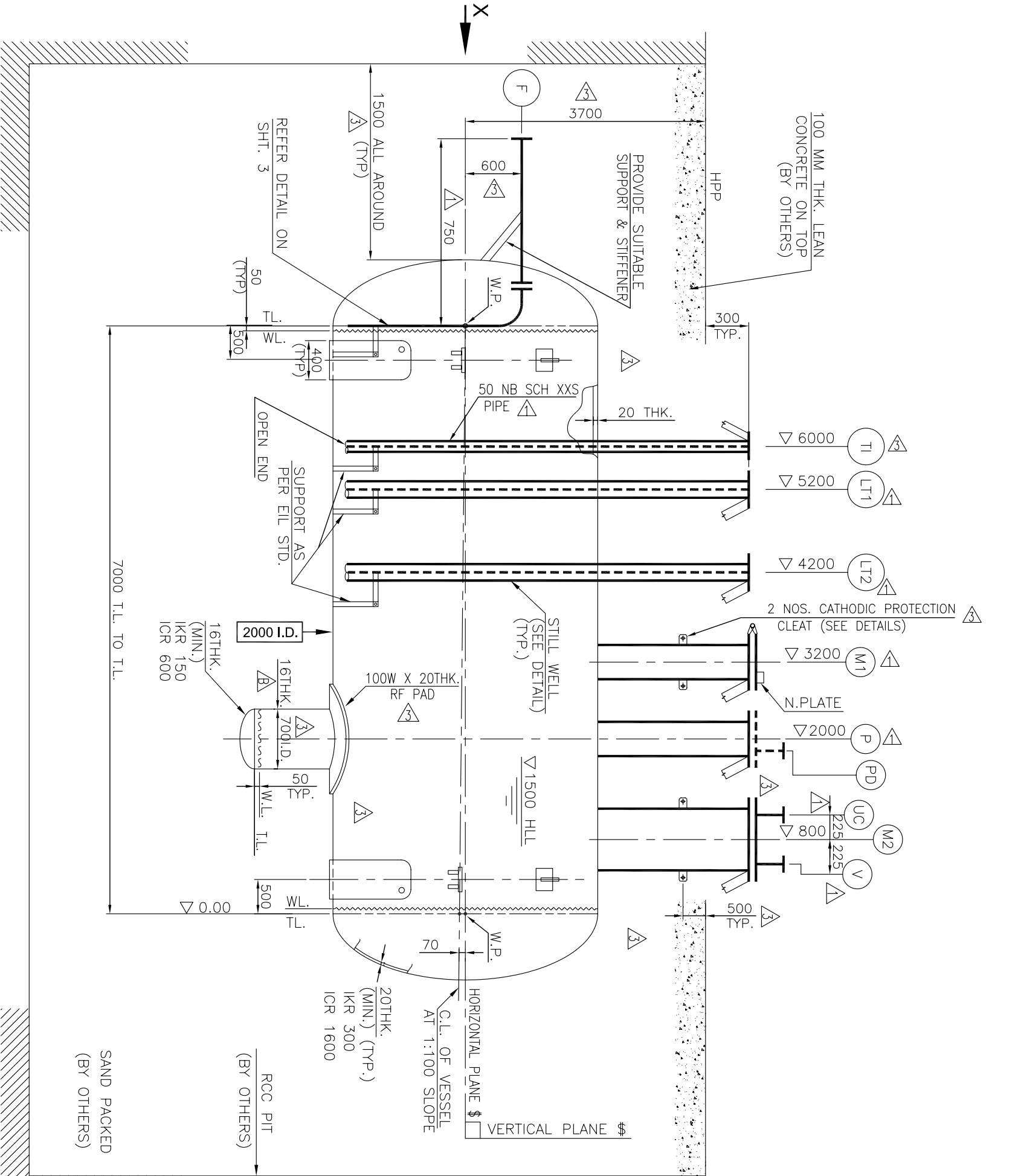
Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.

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FILE NAME : 6907-141-16-46-DS-3066-2-1

FILE NAME : 6907-141-16-46-DS-3066-2-1	NOZZLES AND CONNECTIONS									GENERAL NOTES		SPECIFICATIONS		DESIGN DATA							
	MARK	QTY	NOM. DIA	SCH./THK.	FLANGES			PROJECTION NOTE-4	PAD W x T	SERVICE	UNLESS STATED OTHER WISE		☒	DENOTES APPLICABILITY		CODE		ASME SEC. VIII DIV.1 2007 + ADDENDA' 2008.			
					CLASS	TYPE	FACING				☒	GENERAL SPEC. FOR PRESSURE VESSELS	6-12-0001	WORKING PRESSURE	(kg/cm ² g)	ATMOSPHERIC					
	F	1	100	120 SCH.	150	WN	RF	SEE DWG	—	FEED	1	ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.	☒	SUPP. SPEC. FOR CS VESSELS	6-12-0002	DESIGN PRESSURE	(kg/cm ² g)	INT.	3.5	EXT.	1.05 (F.V.)
	UC	1	50	160 SCH.	150	WN	RF	SEE DWG	—	UTILITY CONNECTION	2	ALL ANCHOR BOLT HOLES TO STRADDLE N/S CENTRELINE-	☒	SUPP. SPEC. FOR BQCS PLATE	6-12-0011	WORKING TEMPERATURE	(°C)	AMBIENT			
	LT1	1	200	80SCH	150	WN	RF	SEE DWG	—	LEVEL INSTRUMENT (RADAR)	3	NORTH DIRECTION WHEREVER SHOWN IS WITH RESPECT TO PLAN VIEW.	☒	STD. SPEC. FOR STRUCTRAL QUALITY PLATES	6-12-0014	DESIGN TEMPERATURE	(°C)	65			
	LT2	1	200	80SCH	150	WN	RF	SEE DWG	—	LEVEL INSTRUMENT (RADAR)	☒	JOB. SPEC. FOR SHOP & FIELD PAINTING	6907-0642-PT-L07	MDMT	(°C)	1					
	M1	1	600	16 THK.	150	WN	RF	SEE DWG	100X20	MANHOLE + BL. FLG. + HINGE COVER					CORROSION ALLOWANCE (MM)	INT.	3	EXT.	1.5		
	M2	1	600	16 THK.	150	WN	RF	SEE DWG	100X20	MOUNTING NOZZLE FOR UC, TI & V.					TYPE OF HEAD	TORISPHERICAL					
	P	1	700	16 THK.	150	WN	RF	SEE DWG	100X20	PUMP NOZZLE					JOINT EFFICIENCY	SHELL	0.85	HEAD / SUMP HEAD	1		
	V	1	80	120 SCH.	150	WN	RF	SEE DWG	—	VENT					RADIOGRAPHY	SHELL	SPOT	HEAD / SUMP HEAD	FULL		
	TI	1	50	XXS SCH.	150	WN	RF	SEE DWG	—	TEMPERATURE INSTRUMENTS					POST WELD HEAT TREATMENT	NIL					
	PD	1	50							PUMP DISCHARGE					HEAT TREATMENT	HEAD / SUMP HEAD (AS PER SPECIFICATION)					
											6	FLANGE GASKET SHALL HAVE 125 AARH FINISH.			OPERATING MEDIUM	NAPHTHA + WATER					
											7	DIMENSIONS OF FLANGES UPTO 600NB SHALL BE AS PER ANSI B16.5 & ABOVE 600NB SHALL BE AS PER ANSI B16.47 SERIES-B, UNLESS OTHERWISE STATED.			WOODEN PILLOWS FOR SADDLE SUPPORT	7-12-0003	SP. GRAVITY	0.67 - 1.0			
											8	ID OF WELD NECK FLANGES SHALL MATCH WITH CORRESPONDING ID OF NOZZLE PIPE/SHELL.			SKIRT BASE DETAILS	7-12-0004	WIND SPECIFICATION	IS 875 (47m/Sec.)			
											9	NOZZLES 50NB AND BELOW SHALL BE STIFFENED WITH 2 NOS. 40 x 8 THK FLATS 90 DEG. APART. MANHOLES & PUMP NOZZLES SHALL BE STIFFENED WITH 8 NOS. 100 x 8 THK FLATS EQUISPACED & OTHER NOZZLES SHALL BE STIFFENED WITH 3 NOS. 40 x 8 THK FLATS EQUISPACED.			SKIRT OPENING DETAILS	7-12-0005	SEISMIC	IS 1893/SITE SPECTRA			
											10	PIPE TO PIPE, PIPE TO FLANGE, PIPE TO FITTING & FITTING TO FLANGE JOINT SHALL BE WELDED WITH THE SAME TECHNIQUE USED FOR MAIN EQUIPMENT WELDING.			ANGLE LEG SUPPORT	7-12-0006	CAPACITY (M ³)	24			
											11 (a)	SIZE OF PUMP NOZZLE 'P' & 'PD' IS UNDER HOLD AND SHALL BE CONFIRMED BY PUMP VENDOR.	☒	MANHOLE WITH HINGED COVER	7-12-0009	FIRE PROOFING	NIL	☐	YES	☐	NO
											11 (b)	PUMP ASSEMBLY WITH BLIND FLANGE, PUMP DISCHARGE NOZZLES, BOLTING AND GASKET SHALL BE SUPPLIED BY PUMP VENDOR.			PIPE LEG SUPPORT	7-12-0007	PAINTING/CLEANING	AS PER JOB SPEC.			
											12	ALL REMOVABLES INTERNALS SHALL BE SIZED TO PASS THROUGH THE MANHOLE.			BRACKET SUPPORT FOR VERTICAL VESSEL	7-12-0008	INSULATION THICKNESS (mm)	NIL	☐	HOT	☐
										13	MANHOLE/NOZZLE NECK/PIPE MADE OUT OF PLATE SHALL BE FULLY RADIOGRAPHED.	☒	MANHOLE WITH DAVIT	7-12-0010	HYDROSTATIC TEST (kg/cm2g)	HORIZONTAL	VERTICAL (AT TOP)				
										14	THE VESSEL SHALL BE LOCATED IN A RCC PIT AND SAND PICKED WITH VIBRO COMPRESSION WITH LEAN CONCRETE ON TOP (100MM THK.). THE PIT HAVE MINIMUM CLEARANCE OF 1500MM ALL AROUND THE VESSEL & 1000 MM (MIN) FROM BOTTOM OF SUMP OF THE VESSEL (RCC PIT BY OTHERS).			LADDER RUNGS FOR MANHOLE/DEMISTER	7-12-0011	PRESSURE (NEW & COLD)	4.55				
										15	THE VESSEL EXTERNAL SURFACE SHALL BE APPLIED WITH SHOP PRIMER & PAINT AS PER EIL SPEC. 6907-0642-PT-L07 AFTER SURFACE PREPRATION (REFER CL 13.13.1 OF TABLE NO. -13 OF JOB SPEC.).	☒	RETAINING PLATE	7-12-0012	INSPECTION BY	☒	EIL	☐	CIB	☐	LLOYDS
										16	VESSEL IS SUBJECTED TO STEAM OUT CONDITION OF 0.5 Kg/cm ² (g) @ 220° C.			NOZZLE REINFORCEMENT AND PROJECTION	7-12-0013	MATERIAL OF CONSTRUCTION (AS PER ASME / IS OR EQUIVALENT)					
										17	ALL CS MATERIAL SHALL BE OF KILLED QUALITY.			PAD NOZZLES FOR VESSELS	7-12-0014						
										18	VESSEL ELEVETION SHALL BE CONFIRMED AFTER GETTING PUMP VENDOR NPSH DATA.	☒	STANDARD BOLT HOLE ORIENTATION	7-12-0015							
										19	ALL FLANGES OF NOZZLES SHALL BE PARALLEL EITHER TO HORIZONTAL PLANE OR VERTICAL PLANE.			ALLOY LINER DETAILS	7-12-0016	SHELL	SA 516 Gr.70				
										20	MOUNTING NOZZLES TO BE CUT (AS NECESSERY) AS PER THE INSTRUCTIONS TO VENDOR DOCUMENT ; VENDOR TO FURNISH DETAILS IN THE DRGS.			SIGHT GLASSES FOR PRESSURE VESSELS	7-12-0017	REINFORCEMENT PAD/INSERT PLATE	SA 516 Gr.70				
										21	CATHODIC PROTECTION BY OTHERS HOWEVER CLIP FOR THE SAME TO BE PROVIDE BY VENDOR	☒	INTERNAL FLANGES	7-12-0018	HEADS / SUMP HEAD	SA 516 Gr.70					
													VORTEX BREAKERS	7-12-0019	SHELL FLANGES	—					
													INLET DEFLECTOR BAFFLE	7-12-0020	NOZZLE FLANGES	SA 105					
													SUPPORT RING AND BOLTING BAR	7-12-0021	NOZZLE NECK UPTO 250 NB	SA 106 GR. B (SEAMLESS)					
													SUPPORT RING SIZES FOR PACKED TOWERS	7-12-0022	NOZZLE NECK ABOVE 250 NB	SA 516 Gr.70					
													PIPE DAVIT	7-12-0023	PIPE FITTINGS	SA 234 GR. WPB (SEAMLESS)					
													LIFTING LUG TOP HEAD TYPE	7-12-0024	GASKET EXTERNAL	SPIRAL WOUND GASKET WITH SS 316 METAL WINDINGS AND GRAFOIL FILLER MATERIAL WITH CS OUTER RING AS PER ASME B16.20					
													FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025							
													EARTHING LUG	7-12-0026							
													NAME PLATE	7-12-0027	GASKET INTERNAL	COMPRESSED FIBRE ASBESTOS FREE					
													MANUFACTURER NAME PLATE	7-12-0028	EXTERNAL STUDS/BOLTS/NUTS	SA 193 GR. B7/SA 194 GR.2H					
													BRACKET FOR NAME PLATE	7-12-0029	INTERNAL STUDS/BOLTS/NUTS	SS 304					
													NAME PLATE FOR SMALL EQUIPMENT	7-12-0030	SKHRT/ SUPPORT	—					
													DETAILS OF FORGED NOZZLES	7-12-0031	SKHRT/ SUPPORT BASE	—					
													SUPPORTS FOR INTERNAL FEED PIPE	7-12-0032	INTERNAL PARTS (WELDED)	SA 516 Gr.70					
													HOT INSULATION SUPPORT FOR HORIZONTAL VESSEL	7-12-0033	INTERNAL PARTS (BOLTED)	SA 516 Gr.70					
													PIPE DAVIT SUPPORT FOR COLD INS. VESSELS	7-12-0034	CLIPS & ATTACHMENTS (EXTERNAL)	SA 516 GR.70					
													TYP. DETAILS OF WIRE MESH DEMISTER SUPPORTS	7-12-0036	WRAPPER PLATE	SA 516 GR.70					
													S.R NOZZLE NECK	7-12-0037	DEMISTER/GRID	—					
													ALLOWABLE NOZZLE LOADS	6907-141-16-46-ST-0038	PAD FOR EXTERNAL ATTACHMENT	SA 516 GR.70					
															NOZZLE DISTRIBUTOR PIPES	—					
															STIFFENERS	SA 516 Gr.70					
															INTERNAL PIPE FOR F. LT1-2, TI.	SA 106 Gr.B (SEAMLESS)/SA 516 GR.70					

FILE NAME : 6907-141-16-46-3066-2-2



NOTE :

1. STRUCTURE SHALL NOTE THAT VESSEL IS WITH THE SLOPE OF 1% (1 IN 100); CONCRETE SADDLE SHALL BE POSITIONED SUCH THAT, THE ABOVE SLOPE IS ACHIEVED WHEN THE VESSEL IS INSTALLED ON SADDLES. FOUNDATION BOLTS IN SADDLE SHALL BE PARALLEL TO VERTICAL PLANE.
2. WHEN THE VESSEL IS IN POSITION, ALL THE NOZZLE C/L SHALL BE PERPENDICULAR TO THE HORIZONTAL PLANE.



ENGINEERS INDIA LIMITED
KOLKATA

JOB NO. : 6907
CLIENT : BCPL
PLANT : OFFSITE

REV.	DATE	REVISION	BY	CHK	APPROVED
3	24.08.2010	REVISED AS MARKED	AR	BVK/PB	AKG
2	10.06.2010	REVISED & REISSUED FOR PURCHASE	JSN	ARD	BBC
1	10.05.2010	REVISED & REISSUED FOR PURCHASE	JSN	ARD	BBC
0	23.03.2010	REVISED & ISSUED FOR PURCHASE	D.KUMAR	ARD	BBC
B	21.01.2010	REVISED & REISSUED FOR BIDS/ENG.	D.KUMAR	ARD	BBC
A	08.12.2009	ISSUED FOR BIDS/ENG.	D.KUMAR	ARD	BBC

ITEM NO.	DESCRIPTION	DRAWING NO.	REV.
160-UV-01	VESSEL DESIGN DATA	6907-141-16-46-DS-3066	3

FILE NAME : 6907-141-16-46-DS-3066-2-3



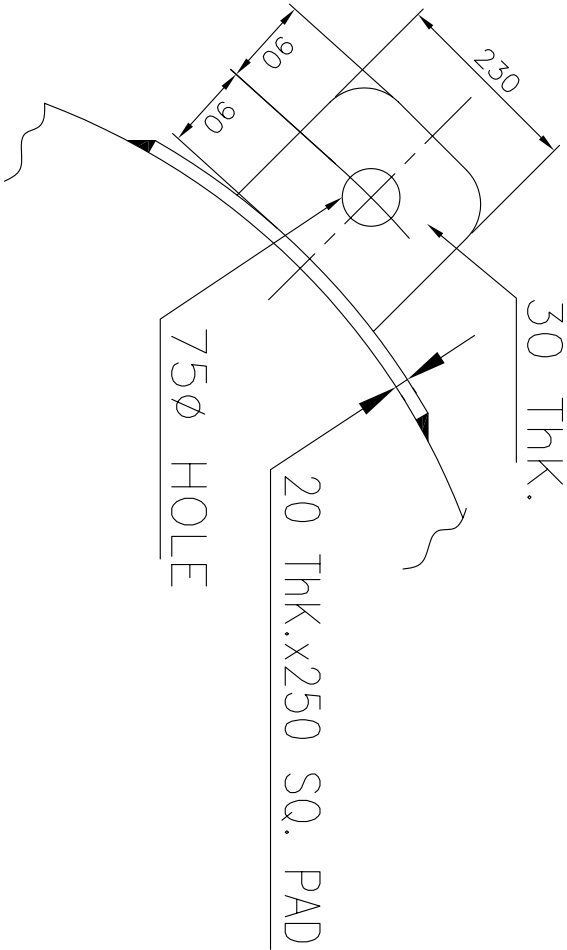
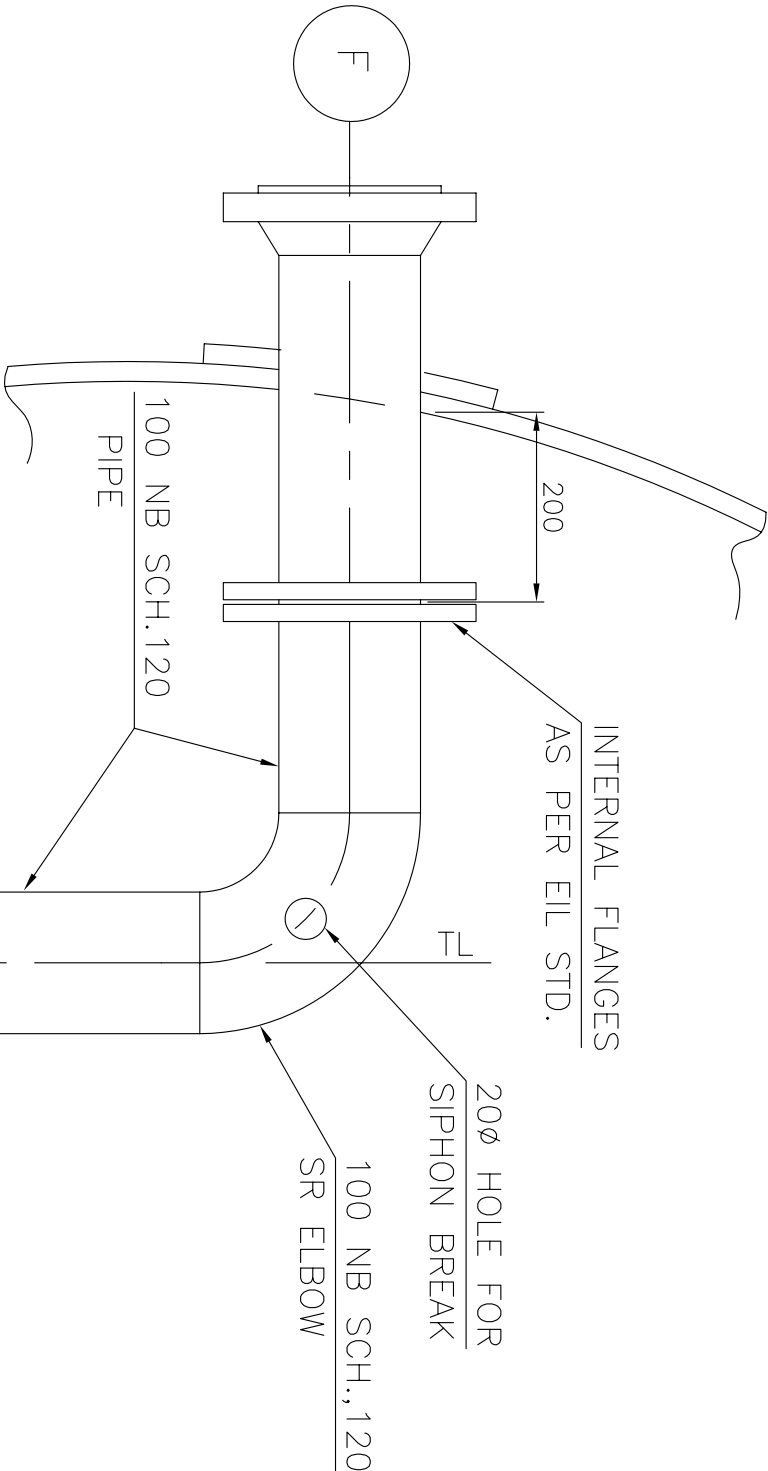
ENGINEERS INDIA LIMITED
KOLKATA

JOB NO. : 6907
CLIENT : BCPL-ASSAM
PLANT : OFFSITE

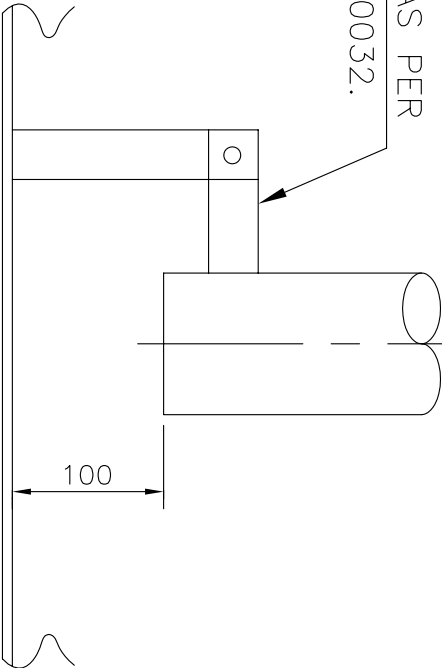
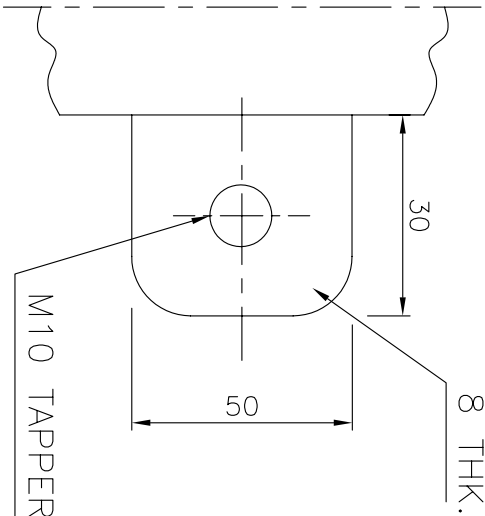
REV.	DATE	REVISION	BY	CHK	APPROVED	APPROVED
3	24.08.2010	REVISED AS MARKED	AR	BVK/PB	AKG	
2	10.06.2010	REVISED & REISSUED FOR PURCHASE	JSN	ARD	BBC	
1	10.05.2010	REVISED & REISSUED FOR PURCHASE	JSN	ARD	BBC	
0	23.03.2010	REVISED & ISSUED FOR PURCHASE	D.KUMAR	ARD	BBC	
B	21.01.2010	REVISED & REISSUED FOR BIDS/ENGG.	D.KUMAR	ARD	BBC	
A	08.12.2009	ISSUED FOR BIDS/ENGG.	D.KUMAR	ARD	BBC	

VESSEL DESIGN DATA	বেসেল ডিজাইন ডাটা
NAPHTHA UNLOADING CBD	নাফথা অনলোডিং
ITEM NO. 160-UV-01	আইটেম নম্বর 160-ইউভি-01

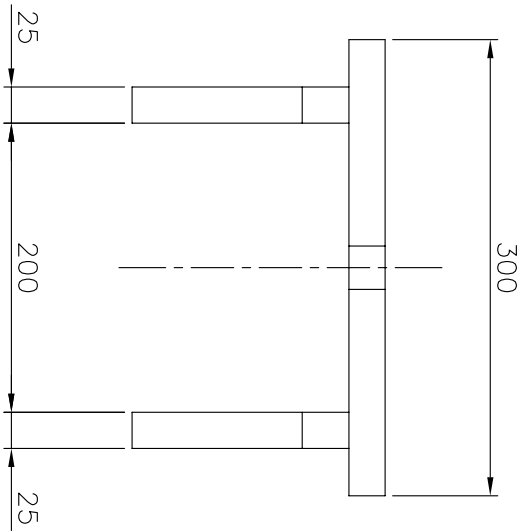
DRAWING NO.	REV.
6907-141-16-46-DS-3066	3
SHEET 3 OF 3	



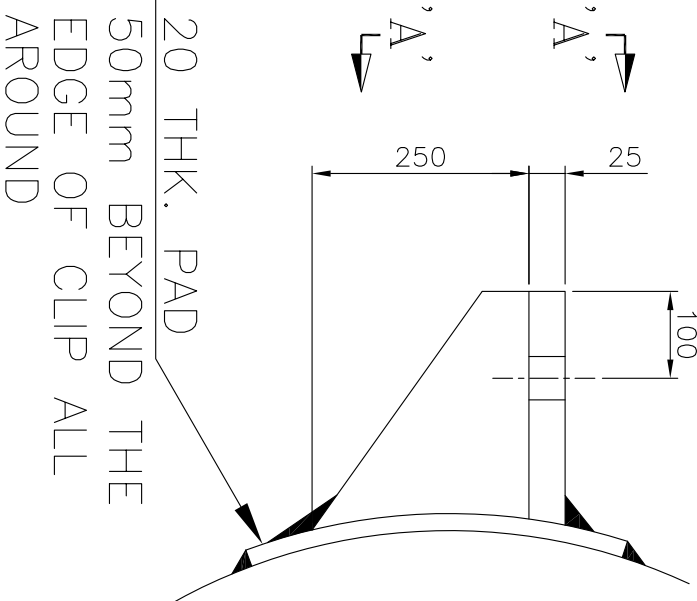
DETAIL OF LIFTING LUG



DETAIL OF NOZZLE-F



VIEW 'A-A'



CLEAT FOR CATHODIC PROTECTION



DETAIL OF BRACKET SUPPORT

SCHEDULE OF QUANTITIES
FOR ERECTION

(PRESSURE VESSELS)

	ENGINEERS INDIA LIMITED KOLKATA	CLIENT : BCPL PROJECT : BPCP UNIT : RAILWAY SIDING TERMINAL LEPETKATA						EQUIPMENT DETAILS FOR ERECTION	DOCUMENT NO.	REV.
			A	31.05.10	BVK	PB	AKG		6907-160-16-46-EE-001 Page 1 of 2	A
			NO	DATE	BY	CHK	APPD			

DEPT.: STATIC EQUIPMENT

JOB NO. : 6907

EQUIPMENT DETAILS FOR ERECTION

TABLE-1: COLUMNS, PRESSURE VESSELS, FILTERS, AIR COOLERS & HEAT EXCHANGERS

SL. NO.	ITEM NO.	DESCRIPTION	QTY. (Nos.)	POSITION (See note 1)	SUPPORT TYPE	OUTSIDE DIA.(mm)	TL TO TL (mm)	OVERALL LENGTH (mm)	UNIT ERECTION WT. (Kgs)	EL. FROM GRADE	REMARKS
1.	160-UV-01	NAPHTHA UNLOADING CBD	1	H	PEDESTAL	2040	7000	8010	13500		Refer note- 2 & 3 below.

* As per equipment layout drawing no. 6907-160-16-43-0001, Rev.A.

NOTES:

- H – Horizontal, V – Vertical.**
- Mechanical contractor scope includes the following mentioned site works, under the supervision of the vessel fabricator as per instructions of Engineer-In-Charge (EIL) w.r.t. the mechanical data sheet.
 - Joining of the mounting nozzle pipes (LT1, LT2, M1, M2, P & TI which will be supplied separately by vessel fabricator), NDT Testing and all other residual engineering activities regarding the erection at the site.
 - The supervision charges by vessel fabricator have been excluded from the mechanical contractor's scope.
- For buried vessels, RCC Pit shall be filled with sand, packed with vibro-compression and 100mm lean concrete shall be provided on top as per instructions of Engineer-in-Charge.

	ENGINEERS INDIA LIMITED KOLKATA	CLIENT : BCPL PROJECT : BPCP UNIT : RAILWAY SIDING TERMINAL LEPETKATA						EQUIPMENT DETAILS FOR ERECTION	DOCUMENT NO.	REV.
			A	31.05.10	BVK	PB	AKG		6907-160-16-46-EE-001 Page 2 of 2	A
			NO	DATE	BY	CHK	APPD			

EQUIPMENT DETAILS FOR PAINTING (PRESSURE VESSELS)

 ENGINEERS INDIA LIMITED KOLKATA	CLIENT : BCPL PROJECT : BPCP UNIT : RAILWAY SIDING TERMINAL LEPETKATA						EQUIPMENT DETAILS FOR PAINTING	DOCUMENT NO.	REV
		A	31.05.2010	BVK	PB	AKG		6907-160-16-46-EP-001 Page 1 of 2	A
		NO	DATE	BY	CHK	APPD			

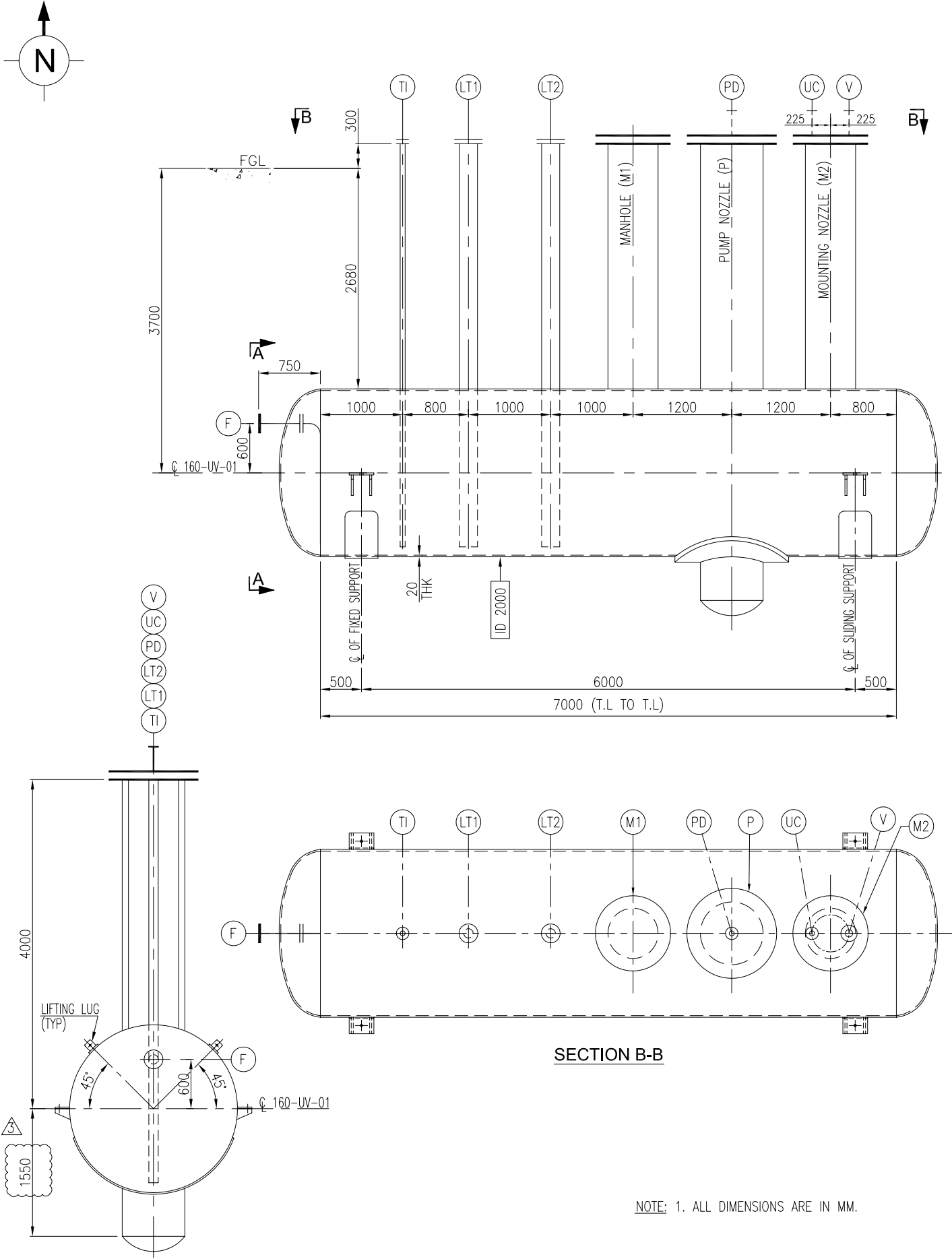
DEPT. :STATIC EQUIPMENT			EQUIPMENT DETAILS FOR PAINTING						JOB NO. :6907	
<u>PRESSURE VESSELS</u>										
SL. No.	ITEM NO.	DESCRIPTION	QTY. (NOS.)	OUTSIDE DIA. (mm)	OVERALL LENGTH OF VESSEL (mm)	POSITION OF EQUIPMENT (See note 2)	APPROX. PAINTING AREA (M²) (10%Extra)	DESIGN TEMP. (°C)	INSULATED (YES/NO)	REMARKS
23	160-UV-01	NAPHTHA UNLOADING CBD	1	2040	8010	H	61.5	65	NO	

- NOTES:**
1. For elevation of equipment from grade, refer to equipment layout attached elsewhere in the Tender document.
 2. **H - Horizontal; V - Vertical**

 ENGINEERS INDIA LIMITED KOLKATA	CLIENT : BCPL PROJECT : BPCP UNIT : RAILWAY SIDING TERMINAL LEPETKATA						EQUIPMENT DETAILS FOR PAINTING	DOCUMENT NO.	REV
		A	31.05.2010	BVK	PB	AKG		6907-160-16-46-EP-001 Page 2 of 2	A
		NO	DATE	BY	CHK	APPD			

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A4-210X297



NOTE: 1. ALL DIMENSIONS ARE IN MM.

<u>SECTION A-A</u>	3	20.08.10	BOOT HEIGHT REVISED	MK	DB/VM	AKG
	2	25.06.10	HOLD REMOVED	MK	DB/VM	AKG
UNIT: RAILWAY SIDING FACILITIES FOR NAPHTHA UNLOADING	1	31.05.10	REVISED AS MARKED	MK	DB/VM	AKG
JOB NO. 6907	0	29.04.10	ISSUED FOR ENGINEERING	MK	DB/VM	AKG
CUSTOMER: BCPL, LEPETKATA	REV	DATE	DESCRIPTION	BY	CHKD	APPD
ENGINEERS INDIA LIMITED RO KOLKATA	NOZZLE ORIENTATION FOR NAPHTHA UNLOADING CBD (160-UV-01)			DRAWING NO.		REV.
				6907-160-52-43-4001		3

JOB SPECIFICATION FOR SHOP & FIELD PAINTING FOR BCPL, ASSAM

0	17.12.07	ISSUED AS JOB SPECIFICATION BY SMMS DEPARTMENT	DR.DNW	GVS	G.V. SWAMY
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
SS	:	Stainless Steel
GI	:	Galvanized Iron
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
DM	:	De-mineralized
ID	:	Internal Diameter
OD	:	Outside Diameter
NB	:	Nominal Bore
RCC	:	Reinforced Cement Concrete
IRN	:	Inspection Release Note

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1.0 GENERAL

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

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

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

2.0 SCOPE

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

2.1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

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

- a. All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All uninsulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.
- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping

- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
 - i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
 - j. Over insulation surface of equipments and pipes wherever required.
 - k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
 - l. Painting of pre-erection/fabrication and Shop primer.
 - m. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.
 - n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.**
- 2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:
- a. Uninsulated austenitic stainless steel.
 - b. Plastic and/or plastic coated materials
 - c. Non-ferrous materials like aluminum.
- 2.3 **Documents**
- 2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.
- a. Bill of quantities for piping, equipment, machinery and structures etc.
 - b. Piping Line List.
 - c. Painting specifications including special civil defence requirements.
- 2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.
- 2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

- 3.1 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract.

IS-5	:	Colour coding.
RAL DUTCH	:	International Standard for colour shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels.
IS-2379	:	Indian Standard for Pipe line identification-colour code.
ASTM-Vol 6.01 & 6.03:		American standard test methods for Paints and Coatings.
ASA A 13.1-1981:		Scheme for identification of piping systems: American National Standards Institution.

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

- 3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.
- 3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).
- 3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).
- 3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.
- 3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.
- 3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:
- Instructions for storage to avoid exposure as well as extremes of temperature.
 - Surface preparation prior to painting shall be followed as per Table 8.0 to 16.0 of this specification shall be followed.
 - Mixing and thinning.
 - Application of paints and recommended limit on time intervals in between coats.

4.0 EQUIPMENT

- 4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data

sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

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

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

- 5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900(latest edition) or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish Standard in case of highly corrosive environment.

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

- 5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of Engineer-in-charge of OWNER/EIL
- 5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.
- 5.1.5 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush.

Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 Procedure of Surface Preparation :

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al_2O_3 particles, chilled cast iron or malleable iron and steel at pressure of $7kg/cm^2$ at a appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron . The combination of steel grits and shots shall be normally in the ratio of 3 : 1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

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

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- a. Hand de-scaling and/or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scraping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, dusted and blow off with compressed

air/steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 Non-Compatible shop coat primer

The paint system followed for Shop coating of structures/equipments etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

- 5.4 Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.
- 5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.
- 5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7 Coating Procedure and Application

- 5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20KM per hour.
- 5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.
- 5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.
- 5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

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

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- h. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.
- j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- k. If spray gun shows choking, immediately de-choking procedure shall be followed.

- 5.7.7 Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

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

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

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

- a. Brushes shall be of a style and quality that will enable proper application of paint.
- b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paint shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be a minimum of brush marks left in the applied paint.
- f. Surfaces not accessible to brushes shall be painted by spray, doublers, or sheepskin.

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

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

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

5.8 Drying of coated surfaces

- 5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.
- 5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.
- 5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 Repair of damaged paint surface

- 5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.
- 5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection pre fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.10 Paint Application

- 5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)
- 5.10.2 Shop priming/ pre-erection priming with F9 or F12 shall be done only with airless spray.
- 5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.10.4 Assessment of painting requirement

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.

- Identify the design temperature from the technical documents
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.11 Documentation

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

TABLE-1 (FOR CLAUSE 5.0)

SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust, loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	profile.				for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

6.0 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, alongwith the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2, 6.3 and 6.4.

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	8-10μ	40-50μ	40-50μ
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	8-10	8-10	8-10	4m ² /kg
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs.	24 hrs.	24 hrs.	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C	NA	80°C	100°C.

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build finish paint.	High build coaltar epoxy coating.
2	Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: polyamide cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum.)	40%.	40%	62%	65%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	30-40μ	100-125μ	100-125μ
5	Theoretical covering capacity in M ² /coat/litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre(minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C	1 hr.	30 minutes.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	16 hrs 5 days	8 hrs NA	16 hrs 5 days	48 hrs. 5 days
9	Over-coating interval at 30 °C	Min.: 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs.	Not applicable	4-6 hrs	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C	60 °C	80°C	125°C.

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%.	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125μ	65-75μ	20-25μ	20-25μ
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50% RH	Min.: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum.)	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (min)	80 °C	400 °C	250°C	500°C.

PAINT MATERIALS
TABLE No. 6.4 FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738 from Ameron Products, USA/ Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note: 6	Two component solvent free type high build epoxy phenolic/Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT (Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100 µm	125- 150 µm
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max. 5 days	Min. 36 hrs Max. 21 days	Min. 16 hrs Max. Not applicable	Min. 16 hrs Max. 21 days
10	Pot life at 30°C for two component paints (minimum.)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (min)	-45°C to 125°C under insulation	-45°C to 150°C under insulation (Note: 5)	Up to 400 deg. C for CS & SS surfaces under insulation	-45°C to 150°C for immersion service

NOTES (for tables 6.1 to 6.4):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through SMMS.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. F-15: Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.
6. F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

‘Amercoat 738’ from Ameron Products USA/Kansai Nerolac Paints Ltd. Mumbai, suitable upto 400°C for CS surfaces and 600°C for SS surfaces.

‘Berger 938’ from Berger Paints Ltd Kolkata, suitable upto 400°C for CS & SS surfaces.

‘Intertherm 751’ from Akzo Nobel Coatings and Sealants Pvt Ltd, Bangalore, Inorganic co-polymer cold applied Aluminium spray coating suitable upto 400°C of CS & SS surfaces.

6.5 List of recommended Manufactures

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

7.0 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area, Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSIFICATION

- **Corrosive Environment-Offsite areas** (excluding Cooling Tower area, DM-plant)
- **Corrosive Environment-Unit areas**
- **Highly Corrosive Environment-Unit & Offsite areas** of a plant with corrosive fumes like HCL, H₂SO₄, Water impingement, Salty water, Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes:

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 16.0.
2. Primers & Finish paints covered in Tables 8.0 to 16.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 7.2.

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0 - 16.0

<u>PRIMERS</u>	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based `ZINGA` zinc primer containing 96% of electrolytic zinc dust in dry film.
<u>FINISH COATS/PAINTS</u>	
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with polyamine hardner
F-6B	High Build Epoxy finish coating cured with polyamide hardner
F-7	High build Coal Tar epoxy coating cured with polyamine hardner
F-8	Self priming surface Tolerant High Build epoxy coating, cured with polyamine hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint.
F-14	Specially formulated coaltar epoxy coating, cured with polyamine hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

**TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING
AFTER ERECTION/WELDING** for all insulated and un-insulated CS, LTCS & low
allow steel items in all environments. (refer clauses 5.4, 5.5 & 5.9)

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40µ DFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.3	401 to 550	SSPC-SP-3	1 coat of F-12	20	-DO-

NOTES:

- 1 The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advise re-blasting and priming again if required.
- 2 The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

TABLE 8.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFFSITE AREAS (excluding Cooling Tower area & DM Plant area) for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
8.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
8.2	-14 to 60	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-2 @ 40 μ DFT/coat	2 coats of F-3 @ 40 μ DFT/coat ; (2x40=80)	185	F-3 paint shall contain pure chlorinated rubber, not modified.
8.3	61 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245	F-12 shall be ambient temperature curing type
8.4	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	3 coats of F-11 @ 20 μ DFT/coat; (3x20=60)	125	Flare lines shall be painted as per Table 9.0.
8.5	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	
8.6	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40)	60	

NOTES

- The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.
- For external surfaces of RCC chimney: 2 coats of F-6 @ 100 μ DFT/coat to obtain 2x100=200 μ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.
- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2
- In case of Paint systems as per Sl Nos 8.5 and 8.6, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 18.0.

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS
for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
9.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6A @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245-255	
9.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @50 μ DFT/coat.	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per SI Nos 9.3 and 9.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCL, H₂SO₄, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipments, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc(Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
10.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
10.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	2 coat of F-6A @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (2x100+40=240)	345-255	
10.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat 2x20=40 or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	
10.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat; (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
3. In case of paint systems as per Sl Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

**TABLE 11.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (EXTERNAL)
All areas (Units & Offsites)**

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
11.1	All external surfaces of shell, internal surfaces of shell above maximum liquid level exposed to atmosphere, wind girders, appurtenances, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasolene, motor spirit, DM water, firewater, raw water, potable water, acids, alkalis, solvents and chemicals etc.					
11.1.1	-14 to 80	SSPC-SP-10;	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 coats of F-6A @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat; (2x100+40=240)	345-355	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat; (80+40=120)	280	
11.1.3	151TO 500	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	2 coats of F-12 @ 20µ DFT/coat; (2x20=40) or 1 coat of F-16 @ 50µ DFT/coat	105-115 OR 115-125	F-12 shall be ambient temperature curing type
11.2	External surfaces of bottom plate (soil side) for all storage tanks.					
11.2.1	-14 TO 80	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
11.2.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	

NOTES

- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

**TABLE 12.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (INTERNAL)**
All Areas (Units & Offsites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 1meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing crude oil, LDO, HSD and Gas Oil (Excluding white oil products)					
12.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 Coats of F-6A @ 100µ DFT/coat; (2x100=200)	305-315	Note-2
12.2	Inside of bare shell of floating roof tanks and cone roof tanks for items mentioned in 12.1					
12.2.1	-14 TO 80	SSPC-SP-10	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	2 coats	DFT need not be measured reconciliation of Chemical used shall be done (Note : 4)
12.3	Floating / Cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, bottom course upto 4 meters height inside shell, underside of floating roof and shell above maximum liquid level, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
12.3.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @ 100µ DFT/ coat; (3x100=300)	365-375	Note-2
12.4	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.3.					
12.4.1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	
12.5	Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.					
12.5.1	-14 to 80	SSPC-SP-10	2 Coats of P-6 @ 40µ DFT/coat; (2x40=80)	2 Coats of F-6B @ 100µ DFT/ Coat; (2x100=200)	280	Note-2
12.6	D.M. (De-mineralized water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories					
12.6.1	-14 to 60	SSPC-SP-10	None	Natural Rubber lining as per SMMS specifications 6-06-204	4.5MM	For DM tanks without steam blanketing
12.6.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	For DM tanks with steam blanketing
12.7	EG(Ethylene Glycol) tanks (internal shell, bottom plate roof and all accessories)					
12.7.1	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer Amercoat 23 @ 75µ /Coat ; (3x75=225)	225	

12.8	Inside pontoon and inside of double deck of all floating roofs.					
12.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	
12.9	Internal surfaces of wet slop, amine, sour water, water draw off storage tanks					
12.9.1	-14 TO 80	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat; (80+80=160)	240	
12.10	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 4meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing Vacuum Residue, Fuel oil, dry slop and other high temperature hydrocarbon liquids.					
12.10.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @ 125μ DFT/ coat; (125+125=250)	375	Note:3
12.11	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.10					
12.11.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	None	125	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
2. F-6A/F6B should be suitable for immersion service of the products given.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is upto 200°C. Cases of operating temperature > 150°C **are not covered in this spec, such cases shall be covered in the job specifications.**
4. The phosphating chemical shall be applied on blast cleaned surface inside the shell of carbon steel storage tanks at the time of erection. In case, any corrosion is observed at the time of commissioning, 2 coats of the phosphating chemical shall be applied at the discretion of Engineer-in-charge.

TABLE 13.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND TANKS IN ALL AREAS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Underground carbon steel plant piping (Yard/ Over the Ditch Corrosion protection Coating)					
13.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25 @μ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @μ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Spec.No 6-79-0011	4 mm	
13.2	Carbon steel plant piping (underground).					
13.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	
13.3	External side of un-insulated underground storage tanks:					
13.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	
13.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	

TABLE 14.0 PAINTING UNDER INSULATION (ALL ENVIRONMENTS)
All areas (Units & Offsites) for insulated Piping, Storage Tanks, Equipments etc
(Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Insulated carbon steel, LTCS and low allow steel Piping, Storage Tanks, Equipment etc					
14.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-14 @ 125µ DFT/coat; (2x125=250) or 3 coats of F-15 @ 80µ DFT/coat ; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking.
14.1.2	126-400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 @ 20µ DFT/coat; (3x20=60) or 1 coat F-16 @ 60 µ DFT/coat	125 – 135	F-12 shall be ambient temperature curing type
14.2	Insulated stainless steel including Alloy-20 piping (Note:2)					
14.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 coats of F-14 @ 125µ DFT/coat;	250	
	0 to 125 (alternate)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15@ 80µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
14.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16@ 125 µ DFT/coat	None	1 coat of F-16@ 125 µ DFT/coat	250	
14.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for the temperature of 600 deg.C and cyclic temperature.
14.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP-10 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	
14.3	No painting is required for insulated monel, incoloy and nickel lines.					

NOTES

1. Refer Notes 1 & 4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to 125 deg.C, both 14.2.1 & 14.2.2 are applicable.

TABLE 15.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS / CONDENSERS
 Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Upto 65	SSPC-SP-10; 1 coat of P-6 @ 40µ DFT/coat	None	2 coats of F-7 @ 125µ DFT/coat; (2x125=250)	290	For CS surfaces
15.2	Upto 65	SSPC-SP-3; 1 coat of P-4 @8-10µ DFT/ coat+ 1coat of P- 6 @ 40µ DFT/coat.	None	2 coats of F-7 @ 125µ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 16.0 PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
16.1	Upto 65	SSPS-SP-3	1 coat of P-4 @8-10µ DFT/ coat + 1 coat of P-6 @ 40µ DFT/coat	2 coats of F-2 @ 40µ DFT/coat; (2x40=80)	130	Shade as per defence requirements
16.2	Upto 65	SSPS-SP-3	1 coat of P-4 @ 8µ DFT/coat.+ 1 coat of P-6 @ 40µ DFT/coat.	2 coats of F-7 @ 125µ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

17.0 STORAGE

- 17.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word “PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE” shall be clearly displayed outside. Manufacturer’s recommendation shall be followed for storage of paint materials.

18.0 PIPING COLOUR CODE:

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

18.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

- 18.1.1 The following ground colour designation for identification of basic classification of various important services shall be followed:

Post Office Red	-	Fire protection materials
Off White/Aluminium	-	Steam (all pressures)
Canary Yellow	-	Chemicals and dangerous materials
Dark Admiralty Grey	-	Crude oil, lube oil
Orange	-	Volatile petroleum products (motor spirit and lighter)
Oxide red	-	Non-volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	-	Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	-	Water (all purities and temperatures)
Sea green	-	Air and its components and Freon

- 18.1.2 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

18.2 COLOUR BANDS AND IDENTIFICATION LETTERING

- 18.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black

letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm wide and regardless of band width, are spaced 25 mm apart when two bands are employed

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel	:	150 mm (Height)
Pump, compressor and other machinery	:	50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

18.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

18.2.3 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

18.2.4 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

18.2.5 Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

18.2.6 Colour band specification:

- | | |
|---------------|------------------------------------|
| a) Unit Area: | Bands at intervals of 6.0 meters. |
| Offsite Area: | Bands at intervals of 10.0 meters. |

- b) Each pipe segment will have minimum one band indication, irrespective of length.
- c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.
- 18.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½" wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.
- 18.4 In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.
- 18.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

RECOMMENDED RAL COLOUR CODE FOR PAINTING OF PIPING AND EQUIPMENT

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE			
			BASE COLOUR		BAND COLOUR	
HYDROCARBON LINES (UNINSULATED)						
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012		2011	
2	CRUDE SWEET	Dark Admiralty grey with 1 red band	7012		3001	
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012		6010	
4	FLARE LINES	Heat Resistant Aluminium	9006			
5	LPG	Orange with 1 oxide red band	2011		3009	
6	PROPYLENE	Orange with 2 blue bands	2011		5013	
7	NAPHTHA	Orange with 1 green band	2011		6010	
8	M.S.	Orange with 1 dark admiralty grey band	2011		7012	
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011	6010	9010	3001
10	GASOLINE (regular, leaded)	Orange with 1 black band	2011		9005	
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011		5013	
12	GASOLINE (white)	Orange with 1 white band	2011		9010	
13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011		3001	
14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011		4006	
15	N-PENTANE	Orange with 2 blue bands	2011		5013	

16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
25	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Black with 1 orange band	9005	2011
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
CHEMICAL LINES				
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000
41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013
48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031

WATER LINES				
51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 yellow bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
FIRE PROTECTION SYSTEM (ABOVE GROUND)				
63	FIRE WATER FOAM & EXTINGUISHERS	Post office red	3002	
AIR & OTHER GAS LINES (UNINSULATED)				
64	SERVICE AIR	Sea green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Sea green with 1 black band	6018	9005
66	NITROGEN	Sea green with 1 orange band	6018	2011
67	FREON	Sea green with 1 yellow band	6018	1023
68	CHLORINE	Canary yellow with 1 oxide band	1012	3009
69	SO ₂	Canary yellow with 2 white bands	1012	9010
70	H ₂ S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021
STEAM AND CONDENSATE LINES (UNINSULATED)				
75	HP STEAM	Off white / Aluminum with 1 yellow band	9006	1023
76	MP STEAM	Off white / Aluminum with 1 red band	9006	3001
77	MLP STEAM	Off white / Aluminum with 1 orange band	9006	2011
78	LP STEAM	Off white / Aluminum with 1 light green band	9006	6021

79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 red bands	5015	3001
Note: For all insulated steam lines, the colour coding shall be follow as given for un-insulated lines with the specified length of color bands.				
INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	1Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001
86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013
90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001
93	CRUDE OUR	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Steel grey	7011	
97	HEATER CASING	Heat resistant aluminium	9006	
98	VESSELS & COLUMNS	Aluminium	9006	
99	HYDROGEN BULLETS	Pink	3014	
100	LPG VESSELS	Oxide red	3009	
101	SO ₂ VESSEL	Canary yellow	1012	
102	HEAT EXCHANGER	Heat resistant aluminium	9006	
103	FO TANK AND HOT TANKS	Black	9005	
104	ALL OTHER TANKS	Aluminum / Off white	9006	

105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004
106	SOUR WATER	Sky Blue	5015
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006
108	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012
109	PUMPS	Navy blue	5014
110	MOTORS & SWITCH GEAR	Bluish green	5024
111	HAND RAILING	Signal red	3001
112	STAIRCASE, LADDER AND WALKWAYS	Black	9005
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
114	GENERAL STRUCTURE	Black	9005
PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
115	IBR	Signal red	3001
116	9Cr-1Mo	Verdigris green	6021
117	5Cr-0.5Mo	Satin blue	5012
118	2 $\frac{1}{4}$ Cr-1 Mo	Aircraft yellow	1026
119	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	Traffic Yellow	1023
120	SS-304	Dark blue grey	5008
121	SS-316	Dark violet	4005
122	SS-321	Navy blue	5014
SAFETY COLOUR SCHEMES			
123	DANGEROUS OBSTRUCTION	Black and alert orange band	9005 2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008

19.0 IDENTIFICATION OF VESSELS, PIPING ETC.

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

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

19.2 Identification of storage tanks:

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

20.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

- 20.1 Following items shall be painted for camouflaging if required by the client.
- All Columns
 - All tanks in Offsites
 - Large Vessels
 - Spheres
- 20.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.
- 20.3 **Method of Camouflaging**
- 20.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).
- | | | |
|------------|-------------|-------------------|
| Dark Green | Light Green | Dark Medium Brown |
| 5: | 3: | 2 |
- 20.3.2 The patches should be asymmetrical and irregular.
- 20.3.3 The patches should be inclined at 30° to 60° to the horizontal.
- 20.3.3 The patches should be continuous where two surfaces meet at an angle.
- 20.3.4 The patches should not coincide with corners.
- 20.3.5 Slits and holes shall be painted in dark shades.
- 20.3.6 Width of patches should be 1 to 2 meters.

21.0 INSPECTION AND TESTING

- 21.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.
- 21.2 Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.
- The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.
- 21.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

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

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

21.4 **Primer Application**

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

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

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

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

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

21.8 At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

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

21.10 The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

22.0 GUARANTEE

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

23.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor who is awarded any job for EIL, Projects under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

24.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

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

- 24.1 The manufacturer should arrange testing of the coating materials as per the list of tests given in para 24.4 below from one of the reputed Government laboratories.
- 24.2 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.
- 24.3 All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed alongwith test report.

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

IICT, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
UICT, Matunga, Mumbai
RITES, Kolkata
PDIL, Sindri
NTH, Kolkata

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

Test required for evaluation of acceptance of coating materials for onshore application.

<u>Test</u>	<u>ASTM Test Method</u>
Density	D 1475
Dipping properties	D 823
Film characteristics	
Drying time	D 1640
Flexibility	D 1737/D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt spray 2000 hrs	B 117
Accelerated Weathering	D 822
% Zn in Dry film for Inorganic Zinc	G 53
Silicate primer	

24.5 Coating systems for panel test shall be decided after discussion with EIL.

24.6 Clause No. 24.0 is for approval prior to award of the contract. In case any agency proposes for any fresh approval after award of work, the same shall have no time implications upon the contract.

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS

Indian Vendors

1. Asian Paints (I) Ltd., Mumbai
2. Berger paints Ltd., Kolkata
3. Kansai Nerolac Paints Ltd., Mumbai (including Ameron, USA Products).
4. Chugoku Marine Paints Pvt. Ltd., Mumbai
5. Shalimar Paints Ltd., Kolkata
6. Sigma Kalon Marine and Protective Coatings(India) Pvt Ltd, Mumbai.
7. CDC Carboline Ltd., Chennai
8. Premier products Ltd., Mumbai
9. Coromandel Paints & Chemicals Ltd., Visakhapatnam
10. Anupam Enterprises, Kolkata
11. Grand Polycoats, Vadodara
12. Bombay Paints Ltd., Mumbai
13. Akzo Nobel Coatings and Sealants Pvt. Ltd., Bangalore
14. Cipy Polyurethanes Pvt. Ltd., Pune
15. Gunjan Paints Ltd., Ahmedabad
16. Advance Paints Ltd., Mumbai
17. VCM Polyurethane Paints (for polyurethane paints only)
18. Jotun Paints India Pvt Ltd, Chennai(Singapore)
19. Paladin Paints and Chemicals , Mumbai
20. Chembond Chemicals Pvt Ltd , Navi Mumbai
21. Aashish Coating Technologies Pvt. Ltd, Vadodara/Mumbai

Foreign Vendors

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

The following are approved for specific materials only.

- 1.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only).
- 2.0 ChemTreat India Ltd.(for Phosphating Chemical and glass flake filled coatings of M/s Atlas Chemicals Corporation, USA).
- 3.0 Carolina equipment and supply Co., USA.
- 4.0 Zinga Metall(Rozenstraat 4-Industrial Zone)-9810 EKE-Belgium, Indian Agent-Newkem, Mumbai-14 (for cold spray zinc coating)

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURERS' PRODUCTS

Sl. No	Manufacturers Name	P2 Chlorinated Rubber Zinc Ph Primer	P4 Etch Primer/ Wash Primer	P6 Epoxy Zinc Ph. Primer	F9 Inorganic Zinc Silicate Primer/ Coating
1	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH.PRIMER RO PC 168	APCONYL WP636 (PC335)	APCODUR HB.ZP. PC433	APCOSIL 605
2	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610 HB PRIMER	ZINC ANODE 304 MZS
3	AMERON PRODUCTS	-	AMERCOAT 178	AMERCOAT 71/ 385P	DIMETCOTE-9FT
4	CHEMBOND CHEMICALS	KEMCHLOR 201	KEMGALVA GRIP A1	KEMOXY 301	KEMGUARD 501
5	SHALIMAR PAINTS LTD	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILIKATE
6	SIGMA KALON INDIA PVT LTD,	SIGMA NUCOL UNICOAT 7321	SIGMA ETCH PRIMER (7185)	SIGMA COVER 256 (7412)	SIGMAZINC- 158
7	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8	PREMIER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB.ZN.PH PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN.PH. HIGH BILD PRIMER	CPC INORGANIC ZINC SILICATE PRIMER
10	ANUPAM ENTERPRISES	ANUHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	ANUZINC 2001 TP
11	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401	-	GP PRIME 402
12	BOMBAY PAINTS LTD.	PENTA CHLOR HB PRIMER 8632	PENTOLITE WASH PRIMER 8520	PENTADUR PRIMER 8530	ZINC-O-SIL 75
13	HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	-	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
14	AASHISH COATING TECH-NOLOGIES				
15	AKZO NOBEL PAINTS	-	-	INTERGARD 251	INTERZINC 12/22
16	PALADIN PAINTS	VEGCHLOR HB PRIMER 1143	VEGWASH PRIMER 1181	VEGPOX 1241ZP	THERMOSIL1362 ZINC
17	VCM POLYURETHANE PAINTS				
18	JOTUN PAINTS		JOTA ETCH TWO PACK WASH PRIMER	EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	RESIST-86
19	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	CHUGOKU MARINE PAINTS PVT. LTD.	-	-	CAMIDECK PRIMER	GALBONS HB
21.	KANSAI NEROLAC PAINTS LTD.	NEROLAC HB CR ZINC PHOSPHATE PRIMER	NEROLAC ETCH PRIMER	NEROLAC EPOXY ZINC PHOSPHATE PRIMER	NEROSIL 118

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (Cont. ...)

Sl. No	Manufacturers Name	F2 Acrylic-Polyurethane Finish Paint	F3 Chlorinated Rubber Finish Paint	F6A/B High Build Epoxy Finish Paint	F7 High Build Coal Tar Epoxy Coating
1	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 319)	APCODUR HB COATING PC 1262	APCODUR CF 651/655(PC 131/471)
2	BERGER PAINTS LTD.	BERGER ACRYLIC PU FINISH	LINOSOL CHLORINATED RUBBER HB COATING	EPLIUX 04 AND 78 HB EPOXY COATING	EPILUX 555
3	AMERON	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
4	CHEMBOND CHEMICALS	KEMTHANE 411	KEMCHLOR 211	KEMOXY 324	KEMOXY 314
5	SHALIMAR PAINTS LTD	SHALITHANE FINISH	CHLORKOTE HB FINISH	EPIGARD TL FINISH POLYAMINE/ POLYAMIDE	BIPIGARD CTE ZL BLACK HB COAL TAR EPOXY COATING
6	SIGMA COATINGS.	SIGMADUR GLOSS (7528)	SIGMA NUCOL FINISH 7308	SIGMA GUARD 720	SIGMACOVER 300 (7472)
7	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBO-MASTIC-14
8	PREMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350/3A, COAL TAR EPOXY COATING
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROTHANE SUPER PU FINISH	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11	GRAND POLYCOATS	GP BOND 141	GP CHLOROGAURD 631	GP GUARD HP234	POLYGUARD CE
12	BOMBAY PAINTS LTD.	PENTATHANE FP 4510	PENTACHLOR FB 4635	PENTADUR HB 5540/5520	PENTADUR COALTAR EPOXY 8518/6518
13.	HEMPEL MARINE PAINTS	-	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
14.	AASHISH COATING TECH	GA 1110 PU-UB		GA701 HB	
15	AKZO NOBEL COAITNGS	INTERTHANE 990	-	INTERGARD 966 / 410	INTERTUF 262 (TAR FREE TYPE)
16	PALADIN PAINTS	VEGTHANE (ALIPHATIC)	VEGCHLOR FP3140	VEGEPOX 3245/3562	VEGEPOX 4265
17	VCM POLYURETHANE PAINTS	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18	JOTUN PAINTS	HARDTOP XP		PENGUARD HB	JOTAGUARD 85
19	KCC PRODUCTS (KOREA)			KOEPOX TOPCOAT HB ET 5740	EH 173
20.	CHUKOGU MARINE PAINTS PVT LTD.	UNY MARINE	-	EPICON MARINE FINISH HB	BISCON HB 2001/ACHB
21.	KANSAI NEROLAC PAINTS	NEROTHANE ENAMEL	NEROLAC HB CHLORINATED RUBBER ENAMEL	NEROPOXY HB 262/6061	NEROLAC EPOXY COAL TAR POLYAMINE/POLY AMIDE CURED.

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (cont. ...)

Sl. No.	Manufacturers Name	F8 Epoxy Mastic Coating Surface Tolerant	F-11 Heat Resistant Synthetic Medium Aluminium Paint	F-12 Heat Resistant Silicone Aluminium Paint	F-15 Two Pack Ambient Temperature Curing Epoxy Phenolic Coating
1	ASIAN PAINTS (I) LTD.	APCODOR CF 640	ASIAN HR ALUMINIUM PAINT (PC 300)	HR SILICONE ALUMINIUM PAINT (PC 189)	
2	BERGER PAINTS LTD.	PROTECTO MASTIC	FERROTOL HR ALUMINIUM PAINT	LUMEROS HR SILICONE AL. PAINT(HR/143)	BERGER EPOXY PHENOLIC COATING
3	AMERON	AMERLOCK 400		AMERCOAT 878	
4	CHEMBOND CHEMICALS	KEMGUARD 555	KEMGUARD 250HR	-	-
5	SHALIMAR PAINTS LTD	EPIPLUS 556	HEAT RESISTING LUSTROL ALUMINIUM	LUSTOTHERM HS SILICONE ALUMINIUM	EPIGARD TL 543 HS FINISH
6	SIGMA COATINGS.	SIGMA COVER 630 (7428)	HIGH TEMPERATURE RESISTANT EPOXY SYSTEM UPTO 200°C	SIGMATHERM 540/SUPER THERMOVIT 600	SIGMA PHENGUARD 930 SYSTEM
7	CDC CARBOLINE LTD.	CARBO MASTIC-15	CARBOLINE 1248	CARBOLINE 4674	
8	PREMIER PRODUCTS LTD.	BH EPOXY MASTIC 150B/150A			
9	CORAMANDEL PAINTS & CHEMICALS LTD.	-	SILVOTOL HR ALUMINIUM PAINT	CPC SILICONE HR ALUMINIUM PAINT	
10	ANUPAM ENTERPRISES	ANU-MASTIC-102	-	ANUPAM HEAT GUARD.	
11	GRAND POLYCOATS	GP PRIME GUARD 235	-	-	
12	BOMBAY PAINTS LTD.	PENTADUR MASTIC 5515	KANGAROO HHR ALUMINIUM 4950	PENTHOLITE HRR ALUMINIUM 4951	
13.	HEMPEL MARINE PAINTS	HEMPDUR 1708			
14	AASHISH COATING TECH	GA700SPE	-	-	-
15	AKZO NOBEL COATINGS	INTERSEAL 670HS	INTERTHERM 891	INTERTHERM 50	INTERTHERM 228
16	PALADIN PAINTS	VEGEPOX MASTIC 2285	VEG HR AL PAINT	VEG HHR AL PAINT 600 DEG C	
17	VCM POLYURETHANE PAINTS	-	-	-	-
18	JOTUN PAINTS	PRIMASTIC UNIVERSAL	JOTUN AL PAINT HR 250 DEG.C	SOLVELITT AL SILICONE PAINT	TANKGUARD STORAGE
19	KCC PRODUCTS (KOREA)	EH 4158H		QT 606	
20.	CHUKOGU J&N LTD.	UMEGUARD MT/SX			
21.	KANSAI NEROLAC PAINTS LTD.	NEROMASTIC 400	NEROTHERM 250	NEROTHERM 538	

Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.