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1. INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields CLIENT (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR(GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2. SCOPE

This Specification covers the general requirements for selection of painting materials, surface preparation, application procedure and inspection for protective coatings to be used for BINK Oilfield Wellhead Facilities and Manifold Extension, EPC Pipeline 8" & 4" and Compressor Station.

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3. NORMATIVE REFERENCES

The latest edition of following codes & standards are applicable in this project (unless otherwise mentioned):

3.1 LOCAL CODE AND STANDARDS

Iranian Petroleum Standard(IPS)

- IPS-E-TP-100 Engineering Standard for Paint
- IPS-C-TP-101 Construction Standard for Surface Preparation
- IPS-C-TP-102 Construction Standard for Surface Painting
- IPS-M-TP-105 Material & Equipment Standard for Asphalt Mastic (cold applied)
- IPS-M-TP-130 Material and Equipment Standard for Colored Alkyd Paint for Top Coat (Finish) Except White
- PS-M-TP-168 Material standard for Acrylic Silicon Finish Paint For Temperature Application up to 200°C
- IPS-M-TP-175 Material and Equipment Standard for Silicone Alkyd Paint (White or Colored) as Top Coat (Finish)
- IPS-M-TP-190 Material & Equipment Standard for Coal Tar Epoxy Polyamide Paint as Primer, Intermediate and Top Coat
- IPS-M-TP-205 Material & Equipment Standard For Zinc Rich Epoxy As Primer, Intermediate & Top Coat
- IPS-M-TP-210 Material & Equipment Standard For Zinc silicate paint As Primer, Intermediate & Top Coat
- IPS-M-TP-235 Material & Equipment Standard For Two Pack Poly Urethane Paint As Top Coat
- IPS-M-TP-220 Material & Equipment Standard for Epoxy Polyamide Intermediate Paint
- IPS-M-TP-225 Material and Equipment Standard for Epoxy Polyamide Paint as Top Coat (Finish)

3.2 INTERNATIONAL CODE AND STANDARDS

Steel Structures Painting Council (SSPC)

- SSPC-P A 1 Paint Application Specification No.1: Shop, Field And Maintenance Painting.
- SSPC-PA 2 Paint Application Specification No.2: Measurement Of Dry Paint Thickness With Magnetic Gauges.
- SSPC-P A3 Paint Application Guide No.3: A Guide To Safety In Paint Application
SSPC-SP COM Surface Preparation Specification Outfaces
Preparation Commentary.
- SSPC-Vis 2 Evaluating Degree Of Rusting On Painted Steel Surfaces.
- SSPC Guide Vis. Guide To Visual Standard No.2: Guide To Standard Method To 2 Of Evaluating Degree Of Rusting On Painted Steel Surfaces

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- SSPC-SP 1 Surface Preparation Specification No.1: Solvent Cleaning.
- SSPC-SP 2 Surface Preparation Specifications No.2: Hand Tool Cleaning
- SSPC-SP 3 Surface Preparation Specifications No.3: Power Tool Cleaning
- SSPC-SP 5 Surface Preparation Specifications No.5: White Metal Blast Cleaning.
- SSPC-SP 6 Surface Preparation Specifications No.6: Commercial Blast Cleaning.
- SSPC-SP 7 Surface Preparation Specifications No.7: Brush-Off Blast Cleaning
- SSPC-SP 8 Surface Preparation Specifications No.8: Pickling
- SSPC-SP 10 Surface Preparation Specifications No.10: Near-White Blast Cleaning
- SSPC-Paint 20 SSPC Paint Specifications, Zinc-Rich Primers (Type 1- "Inorganic", & Type 11- "Organic").
- SSPC-Vol. 1 Steel Structures Painting Manual.

American Society of Testing Materials (ASTM)

- ASTM D3359 Standard methods for measuring adhesion by tape test.
- ASTM D2697 Volume non-volatile matter in clear or pigmented coatings.
- ASTM A153 Specification for zinc coating (hot-dip) on iron and steel
- ASTM A123 Specification for zinc (hot galvanized) coatings on products fabricated from rolled, pressed and forged steel shapes, plates bars and strip
- ASTM A143 Practice for safeguarding against embrittlement of hot-dip galvanized structural steel products and procedure for detecting embrittlement
- ASTM B117 Standard method of salt spray (Fog) testing.
- ASTM D95 Standard test method for water content
- ASTM D185 Standard Test Methods For Coarse Particles In Pigments, Pastes, and Paints
- ASTM B96 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- ASTM A 385 Practice For Providing High Quality Zinc Coatings (Hot Dip)
- ASTM D522 Standard Test Methods For Mondvel Bend Test Of Attached Organic Coating.
- ASTM D562 Standard Test Method For Consistency Of Paints
- ASTM D1308 Standard Test Method For Chemical Resistance On Clear And Pigmented Organic Finishes
- ASTM D1014 Standard Test Method for Conducting Exterior Exposure Tests of Paints On Steel
- ASTM A1640 Standard Test Methods for Drying, Curing Or Film Formation of Organic Coating at Room Temperature.
- ASTM D3951 Practice for commercial packaging
- ASTM D4285 Standard Test Method for Indicating Oil or Water in Compressed Air
- ASTM D4366 Standard test method for hardness of organic coating

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British Standards (BS)

Methods of test for paints.

- BS 3900

International Organization for Standardization (ISO)

ISO 8502-3

Preparation of steel substrates before application of paints and related products

ISO-M-21809-3

External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 3: Field joint coatings

ISO 16961

Internal coating and lining of steel storage tanks

BS EN 10289

Steel tubes and fittings for onshore and offshore pipelines. External liquid applied epoxy and epoxy-modified coatings

American Water Works Association (AWWA)

- AWWA C-210 Liquid Epoxy Coating Systems For The Interior and Exterior of Steel Water Pipe Lines
- SIS 05 5900 Preparation of steel substrates before application of paints and related products-visual assessment of surface cleanliness.
Part 1: rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coating.
- RAL-K1 Uebersichtskart (Color Chart)
- NACE SP 0198 Control of Corrosion Under Thermal Insulation and Fireproofing Materials—A Systems Approach
- NORSOK M501 Surface preparation and protective coating

3.3 PROJECT DOCUMENTS

- BK-SSGRL-PEDCO-110-PI-SP-0001 Piping Material Specification
- BK-PPL-PEDCO-320-PI-SP-0001 Piping Material Specification
- BK-GCS-PEDCO-120-PI-SP-0001 Piping Material Specification
- BK-GNRAL-PEDCO-000-PI-SP-0004 Specification for Metallic pipes
- BK-GNRAL-PEDCO-000-PI-SP-0005 Specification For Fittings, Flanges, Gaskets and Bolts
- BK-GNRAL-PEDCO-000-PI-SP-0017 Specification For Cleaning and Flushing

3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001".

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3.5 ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

4. TECHNICAL SPECIFICATION

All painting materials shall be furnished in unopened containers and shall be labeled as to identify them as material specified for the job.

All painting material shall be boxed and vigorously stirred for a time sufficient to thoroughly mix again the pigments and vehicles.

Thinners shall be supplied from the paint manufacturer.

If painting material requires the addition of a catalyst, the pot life under application conditions shall be clearly stated on the label

General description of painting materials and reference number of paints to be used for this project are indicated in Table 1.

Before proceeding with any purchasing actions by EPC contractor, the list of painting manufacturers shall be reviewed and confirmed by CLIENT.

5. PAINT SCHEDULE

Project surface preparation and paint schedules are indicated in Tables 2. All temperature ranges indicated in the table are maximum operating of the pipe and/or equipment and not design temperatures. Dry film thicknesses as shown in Tables 2 to be minimum requirement.

The color schedule given in Table 3 shall be used for appearance and identification of steelworks, pipe works, equipment, instruments, tanks, machineries safety and fire equipment etc.

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TABLE 1-PRIMERS AND PAINTING MATERIALS

ITEM	GENERAL DESCRIPTION	IPS NO.
105	Asphalt mastic (cold applied)	IPS-M-TP-105
168	Acrylic Silicon Finish Paint for Temperature up to 200°C	IPS-M-TP-168
190	Coal Tar Epoxy Polyamide Paint as Primer, Intermediate and Top Coat (Finish)	IPS-M-TP-190
205	Zinc-Rich Epoxy Paint (Organic Zinc-Rich)	IPS-M-TP-205
210	Zinc Silicate (Inorganic Zinc Rich) Paint	IPS-M-TP-210
220	Epoxy Polyamide Intermediate Paint	IPS-M-TP-220
225	Epoxy Polyamide As Top Coat	IPS-M-TP-225
235	Two Pack Aliphatic Polyurethane Paint	IPS-M-TP-235
-	Silicon Aluminum Intermediate and Top Coat	-
-	Solvent Free Epoxy	-

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Service	Surface Prep. No SSPC/ SWEDISH	Temp. Range (C)	Primer		Inter. Coat		Finish Coat		Paint System
			IPS NO.	D.F.T. (Mic)	IPS NO.	D.F.T. (Mic)	IPS NO.	D.F.T. (Mic)	
8. External surfaces of Storage tanks (See Note 2)									
8.1 Shell & fixed roof	10 / Sa 2 1/2	Up to 120	205	75	220	80	235	50	A
	5 / Sa3	121 to 200	210	70	168	25	168	25	B
	5 / Sa3	201 to 400	210	70	Silicon Aluminum	25	Silicon Aluminum	25	C
8.2. Stairways, Stair Tread, gangway, Staying & Other External Parts	10 / Sa 2 1/2	Up to 120	205	75	220	80	235	50	A
	or galvanized								
9. X-Massa Tree, Casing Head Spool Assembly, Casing Head Housing, Base Flange, Plate, Underground structures such as valves in valve boxes in underground gas pipeline, Anchor Flanges (Note 3)	10 / Sa 2 1/2	Up to 80	Solvent Free Epoxy (Note 2)	1500	-	-	235	50	F

General Notes:

- G system is selected based on NACE SP0198 (System CS1). Also, requirements of NORSOK M501 and API RP 583 shall be met for this paint system.
- Prior to purchase of Solvent Free Epoxy Paint, laboratory tests based on operating temperature shall be performed based on ISO16961 and ISO21809-3 and approved by CLIENT.
- For other parts of wellhead facilities "paint system A" shall be used.
- Shot or grit blasting is used for surface preparation.
- For painting of interior surfaces, refer to the project Technical Specification for Lining (Internal Protection of Equipment by Painting), Doc. No. BK-GNRAL-PEDCO-000-PI-SP-0007.
- All three layer of painting shall be supplied from same manufacturer.
- All Blasting and painting material shall be supplied from project's AVL through technical proposal.

For equipment subject to paint damage during transportation, installation, etc., the equipment manufacturer shall quote the painting system used (painting layers and paint manufacturers) for future use of touch-up painting.

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6. PAINT COLOR SCHEDULE

The color schedule given in Table 3 shall be used for appearance and identification of steelworks, pipe works, equipment, instruments, tanks, machineries safety and fire equipment etc.

Table 3-PAINT COLOUR SCHEDULE FOR STRUCTURES. PIPEWORKS. TANKS AND SAFETY AND FIRE EQUIPMENT

NO.	STRUCTURES /ITEMS	COLOR	RAL NO.
1	Pipe supports	Same as surrounding	-
2	Lighting posts	White	9010
3	Guard rails (Handrails)	Traffic Yellow	1023
4	Pedestal cranes (moving parts)	Red/white stripes	3001
5	vessels	Tele gray 4	7047
6	Pipe work (Sour Gas)	Tele gray 4	7047
7	Pipeline Sour Gas	Tele gray 4	7047
8	Instruments (Panels, Control Consoles and Instruments)	Brilliant Green	6032
9	All equipment and packages	Light grey	7047
10	Control Panels	Light grey	7035
11	Moving parts and overhead obstructions	Red/white stripes	3001
12	Stairways and associated structures	Traffic Yellow	1023
13	Floors and walkways	Brown red	3009
14	Doors	Green	6001
15	Grating	Same as support frame color	-
16	Netting framing	White	9010
17	Flare (excepted top of flare to be aluminium)	Signal Yellow /white	1003/9010
18	Structural Steel	Tele gray 4	7047
19	Floors and walkways	Brown red	3009
20	Doors	Green	6001
21	Fire Fighting Purposes	Red	3000

7. VENDOR DATA

Vendor shall provide 6 sets of coating and paint materials method of preparation, mixing and application procedures and data in the following manner:

- Two sets with proposal
- Four sets with each consignment

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In case some coating and paint materials require special chemicals and/or thinners, sufficient amount shall be provided with each consignment bearing in mind item 6.1 above. The required amount of such chemicals, additives, agents or thinners shall be clearly stated in vendor's proposal.

Each coating and paint material container, in addition to paint manufacturer's standard commercial information, shall bear the CLIENT's reference number as stated in this specification, date of manufacture, shelf life and pot life.

All paints, primers and solvents (when recommended by paint vendor) shall be supplied in 20 lit. Containers unless manufacturer recommends otherwise.

8. APPLICATION

All work carried out by the Painting Contractor shall be subject to the approval of Owner's representative. The inspector shall have the right to reject any of the performed work which in his opinion does not conform to this specification.

The Painting Contractor's responsibilities shall include but not be limited to furnishing of all manpower, tools, materials, consumables, transportation, inspection requirements, etc. required for surface preparation and painting.

Whilst the content of this specification defines the essential requirements of surface preparation and painting, they do not relieve the Painting Contractor from his responsibility to carry out the work in accordance with the appropriate codes standards listed in section 3.

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

- Proper storage to avoid exposure, as well as extremes of temperature
- Surface preparation prior to painting
- Mixing & thinning
- Application of paints and recommended limit on time intervals between coats.
- Pot-life of two-pack materials.
- The minimum time before over coating
- The maximum time, if any, to over coating for proper adhesion between coats.

The following materials do not require shop or field painting:

- Stainless steel,
- Nickel, aluminum,
- Galvanized iron
- Other metals not subject to corrosion, concrete and masonry surfaces.

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Precautions shall be taken to prevent paint from being applied to nameplates, couplings, shafts, valve stems, bearings, control valves, instrument glasses, moving parts and other machined surfaces.

It is intended that to the extent possible, surface preparation and coating to be performed in the Painting Contractor's yard to minimize site work.

All equipment supplied by CLIENT such as vessels, coolers, machinery and their associated panels shall be painted in fabricators shop by the equipment suppliers. The Painting Contractor shall perform touch up painting and repaint those areas of equipment where the coating has been damaged during shipment and transit.

All prefabricated piping systems and steel structures shall be (primed) in the Painting Contractor's shop prior to installation at the site.

The Painting Contractor shall investigate the painting of the overall system after erection and tests. The touch up painting of the damaged areas with primer coat and application of the intermediate and top coats shall be carried out after tests.

9. SURFACE PREPARATION

Surfaces to be painted shall be cleaned and prepared before any paint is applied.

All oil and grease, dirt, welding slag and fume deposit, rust and loose mill scale, prevent good adhesion and should be removed. Weld edges shall be free from weld spatter.

Welds and edges shall be ground smooth and comers rounded and the weld areas shall be cleaned of salt deposits, etc.

Particular care should be taken to prevent rusting and/or contamination of cleaned or primed surfaces.

Blast cleaning shall not be carried out on wet surfaces or surfaces which will be wet after blasting; nor shall blast cleaning be carried out when surface temperature is less than 3oC above ambient dew point, or when the relative humidity is greater than 80% or beyond daylight hours on exterior location.

Prepared surfaces should be primed generally within four hours or before visible re-rusting occurs.

Cleaned surfaces shall never be left overnight prior to coating, in such case re-blasting or re- cleaning is necessary.

No acid washes or other cleaning solutions or solvents shall be used on metal surfaces that have been blasted. This includes inhibitive washes intended to prevent rusting.

Chipping, scraping and Steel wire brushing using manual or power driven tools can not remove firmly adherent mill scale and shall only be used where blast cleaning is impractical, with the approval of client and in accordance with the grade ST2 - ST3 as will be specified.

Surface irregularities including weld spatter, rough capping, undercut and slag together with sharp or rough edges and burrs, surface laminations and laps shall be removed or made smooth prior to commencement of surface preparation. Such irregularities which become apparent after surface preparation by blast cleaning or hot acid pickling shall be similarly treated.

Blasting operations shall never be allowed in the vicinity of painting work or near to a wet paint surface. Metallic abrasives such as copper slag, cast steel or chilled iron shot or grit shall be used as abrasives for blast cleaning of steel surfaces. Size and hardness of shot and grit abrasives shall be according to the requirements of Table B1 of IPS-C-TP-101. In general, the acceptable sizes of abrasives shall be within the range of 0.50 to 1.68 millimeter. This range shall be 0.2 to 0.5 mm for temperature resistant paint surfaces. Non-metallic abrasives such as silica sands shall not be used for blast cleaning.

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All abrasives shall be free of dust, dirt and other foreign matter and shall be kept dry at all the times. Residual shot, grit and dust shall be completely removed after blasting preferably by vacuum cleaning, but otherwise by air blast or fibber brush.

Compressed air supply used for blasting shall be free of water and oil adequate separators and traps shall be provided and these shall be kept emptied of water and oil Accumulations of water and oil shall be removed from the air receiver by regular purging.

This clause shall also apply to air used for the dusting of cleaned surfaces. The pressure and the volume of compressed air supply for blast cleaning shall meet the work requirement.

The surface preparation specified shall be in accordance with Swedish standards SIS 055900 or B.S or SSPC standards. The level of cleanliness in different standards are as indicated here below:

Type of surface preparation	SIS 055900	SSPC	BSI
Hand Tool Cleaning	ST 2	SP-2	-
Power Tool Cleaning	ST 3	SP-3	-
White Metal Blast Cleaning	SA 3	SP-5	First Quality
Near White Blast Cleaning	SA 2 1/2	SP-10	Second Quality
Commercial Blast Cleaning	SA2	SP-6	Third Quality

Shop primed and other previously painted surfaces scheduled for painting shall be examined for bare and marred spots. All such areas shall be adequately prepared, cleaned and touched-up with matching type priming materials before application of other paint.

Blast cleaned surfaces may be protected for short periods by a thin coat of pre-treatment or pre-fabrication primer. It is imperative that such gap primers should be applied as a continuous coating in an even manner to achieve a minimum film thickness of 20 microns. Such primers do not replace the full thickness of permanent primer.

During inspection of blast cleaned surfaces, dust test shall be performed based on BS EN ISO 8502-3. Maximum Class 2 is allowed.

10. STORAGE AND PREPARATION OF PAINTS

Paints shall be stored in a well-ventilated store room, away from sunshine or excessive heat. The paints shall be maintained at a temperature between 4oC and 27oC. However, the manufacturer's instructions for storage temperature shall also be considered. Open air storage shall be avoided particularly for primers and undercoats.

The maximum storage time for paints shall be in accordance with the manufacturer's instructions.

Paint drums/cans shall not be opened unless required for use. The label information shall be legible in accordance with code and shall be checked at the time of use.

The drums of heavy paints which settle during storage period shall be rolled every six weeks. Turning the drums on their ends is not allowed.

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Paints shall not be used if it has gelled, or if it has thickened to such an extent that more than 5% by volume (10% by volume for priming paints) of the correct thinners is required to bring it to brushing consistency.

Where a skin has formed in the container, the skin shall be cut loose from the sides of the container, removed and discarded. If the volume of such skins is more than 2% of the remaining paint, the paint shall not be used.

Mixing shall be carried out by powered mixers and/or shakers. Only small quantities shall be mixed by hand mixing (See clause 10.13). Mixing directions as furnished by the manufacturer shall be followed. Mechanical agitation during application shall be sufficient to keep pigment in solution.

Mixing in open containers shall be done in a well-ventilated area away from sparks or flames.

Paints mixed in original container shall not be transferred until all settled pigment is incorporated in the vehicle.

Paints shall not be mixed or kept in suspension by using a bubbling air stream.

Paint shall not remain in spray pots or buckets overnight but shall be gathered in a closed container and remixed before use.

When mixing two-component paints, check and remix each component individually. Then blend the two components at low speed until the mixture is completely uniform in color. Often, the two components are supplied in different colors so that a good mix can be achieved. Do not mix more than a few liters at a time since the exothermic caused by the mixture may be so high as to make the paint solidify in the container.

Hand mixing of paints is allowed for only containers up to 5 liters. All large containers shall be rolled on its side before opening, then mixed by mechanical agitators and brought to a uniform consistency. Where pigment separation readily occurs such as heavy or metallic pigments, prevention shall be made for continuous mixing during application.

Paint shall be thinned in accordance with the manufacturer's instructions. Only thinners of the type recommended by the paint manufacturer shall be used.

11. PAINTING APPLICATION

All painting shall be carried out in conformity with this specification and with the paint manufacturer's recommendation.

The accepted methods of applying coating on site are by Airless spray.

Painting Contractor shall be responsible for ensuring that he is in possession of the latest available issue of the paint data sheets and product safety data sheets printed by the paint manufacturer of the particular batch of paint to be applied. Such data shall include specific recommendations and instructions concerning shelf life, pot life thinners.

Directions for thinning and mixing, drying time, curing time, recommended spray equipment, safety equipment, cleanings solvent and any other provisions for application of both prime and finish coats. Product safety data sheets shall include information concerning general composition, physical data, hazards and precautions during and after application, toxicity/first aid, storage, spillage and waste disposal.

These recommendations shall be considered an inherent part of this standard and followed accordingly.

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Painting Contractor shall avoid contamination of any adjacent items of plant and equipment by paint overspray, drips or spillage, providing appropriate protection where necessary. Stainless Steel and high Nickel-Chromium alloy surface shall be protected against overspray or paint drips, particularly those containing metallic pigments. If any such contamination does occur, the paint shall be immediately and thoroughly removed by Painting Contractor

Painting shall not take place under adverse weather conditions, in particular rain, fog, snow or when such conditions are likely to occur before the paint has become dry.

Painting shall not take place in the following conditions:

- a. At temperatures below 5°C.
- b. When the relative humidity is greater than 85%.
- c. When the metal surface temperature is less than 3 °C above the ambient dew point.
- d. Outside daylight hours on exterior locations.

In the case of exterior locations, painting may also be suspended due to wind speed at the discretion of Owner. In cases where moisture tolerant coatings are used, painting may proceed on damp surfaces within the limits recommended by the manufacturer of the particular coating being applied.

The method of application shall be selected to ensure that the paint is applied in a uniform manner to the prescribed film thickness without any runs, sags or other blemishes. The pressure and volume of the compressed air used for spray application shall meet the work requirement and be free from oil and water contamination. Traps, separators and filters shall be emptied and cleaned regularly. Application of primers on wire brushed surfaces shall be by brush.

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

- 11.1.1 Brushes shall be of a style and quality that will permit proper application of paint. Round or oval brushes generally are considered most suitable for rivets, bolts, irregular surfaces and rough or pitted steel wide flat brushes are suitable for large flat areas, but they should not have a width of over 125mm.
- 11.1.2 The brush shall not be dipped more than one-third of bristle length into the paint to avoid overloading the bristles and filling the "heel" with paint. The brush shall be held at an angle of about 45° to the work.
- 11.1.3 The brushing shall be done so that a smooth coat, as nearly uniform in thickness as possible is obtained. There should not be deep or detrimental brush marks.
- 11.1.4 Excessive pressure shall not be applied to the brush. When the surface has been completely covered with paint, the wet area shall be brushed cross-wise to ensure uniformity, and finally brushed lightly to smooth out brush marks and laps. On large areas this final light brushing shall be in vertical direction.

Air spray application shall be in accordance with the following:

- 11.1.5 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 application equipment shall be kept in satisfactory and perfectly clean condition to permit proper paint application. Moisture traps or separators

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

- 11.1.6 The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The atomizing air pressure on the gun shall be high enough to atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or loss by overspray.
- 11.1.7 Sprayed coating shall be cross-spray-applied to ensure uniform coverage free of runs and sags.
- 11.1.8 The spray gun shall be held at right angles to work and make even passes. The passes shall be overlapped by 50% on the previous one. The trigger of the gun should be released at the end of each stroke.
- 11.1.9 At the end of each day or upon completion of the job, the gun shall be cleaned thoroughly by spraying the thinner through the gun and forcing it into container by holding the cloth over the air cap. The air cap shall be removed and the fluid tip washed with thinner. The cap shall be immersed in thinner and the holes cleaned with a matchstick but not with nail or wire. The spray gun shall never be immersed in the thinner. The gnu shall be lubricated at regular intervals.

Airless spray application shall be in accordance with the following:

- 11.1.10 Since very high pressure is involved in this method, caution shall be exercised in the handling of airless spray equipment; in particular, the spray gun shall never be pointed towards any part of body whilst the equipment is in operation.
- 11.1.11 Fluid tips shall be of proper orifice size and fan angle, and the fluid control gun of proper construction, as recommended by the manufacturer of the material being sprayed and the equipment being used. Fluid tips shall be of the safety type with shields to prevent penetration of the skins by the high pressure stream of paint.
- 11.1.12 For good results the gun shall be held at right angle to the work and about 300mm away and the operator should start at the bottom and work upwards. The speed of the operating strokes should be much faster than for normal spraying.
- 11.1.13 Successive passes of the gun shall overlap only slightly since the spray pattern is of uniform thickness throughout its width. Paint must never be allowed to dry in the gun. Cleaning instructions must be strictly followed.
- 11.1.14 Airless paint spray equipment shall always be provided with an electric ground wire in the high pressure line between the gun and the pumping equipment. Further, the pumping equipment shall be suitably grounded to avoid the build-up of any

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electrostatic charge on the gun. The manufacturer's instructions shall be followed properly in this respect.

11.1.15 Inorganic zinc rich paints shall be applied by airless spray method.

To ensure that the minimum thickness is achieved on all angles, comers, bulkheads, welds, etc., such edges shall be stripe painted separately before applying the main system. Holding primers shall only be permitted where they are obtained from the same manufacturing source as the main priming coats, and where the manufacturer is able to provide a full guarantee that satisfactory inter-coat adhesion will occur. No painting shall be put on edges prepared for field welds or within six inches of these edges.

Where further painting is to be carried out, Zinc Silicate primers shall be sealed with a tie coat as soon as practical after complete curing has taken place, to avoid salt or chemical contamination and to seal the porous nature of the primer. The tie coat shall be selected to ensure sound adhesion to the Zinc Silicate primer and be compatible with the finishing coat process. Overspray and dry spray of inorganic Zinc Silicate primers shall be removed prior to application of subsequent tie coats or top coats.

In all instances where two or more coats of the same paint are specified, such coatings shall be of contrasting colors so that each stage of the work can be readily identified and film thickness determined accordingly.

Intervals between coats shall comply with manufacturer's recommendations and should generally be kept to the absolute minimum in order to prevent contamination between coats. Where contamination occurs between coats, this shall be completely removed, generally by washing with a suitable detergent solution and rinsing with clean fresh water.

All points of damage to paintwork incurred at any stage of the work, including shop welding operations, shall be re-prepared by blast cleaning to the original standard and recoating with the specified priming coat to restore the film thickness. In all such instances preparation shall extend 25 mm into the sound paintwork and a further 25mm of sound paintwork shall be lightly blasted to etch the surface. Repainting shall then cover the prepared surface and the etched paintwork.

Preparation of weld margins shall be preceded by the removal of masking tape where fitted and shall involve the removal of all flux, welding spatter and other foreign matter. Where blast cleaning is used, this may be by means of portable vacuum blast apparatus. Where power wire brushing is used, excessive cleaning to the extent this is liable to produce a polished surface shall be avoided.

Where touching up prior to top coating of Zinc based primers involved, this shall be preceded by thorough cleaning with solvent or an emulsion type cleaner to remove all oil and grease. This shall be followed by thoroughly hosing down with clean potable water which in the case of surfaces that have not been tie coated shall be carried out in conjunction with manual scrubbing with stiff brushes in order to remove all surface dirt and other contaminants, Zinc corrosion products (white rust), etc.

After the preparation described in clauses 11.19, 11.20 the surfaces shall be allowed to thoroughly dry out and shall be subjected to a thorough inspection to establish effectiveness of the cleaning operations. Prior to start the project, evaluation of paint applicators shall be performed in the presence of CLIENT's representative (Material Corrosion Office).

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12. PREPARATION OF SHOP PRIMED SURFACES FOR OVER COATING

Before installation of equipment, all three layers of paint shall be applied in shop by allowed time intervals between coats. Any repair and touch up after installation at site is in CONTRACTOR's scope of work.

13. SAFETY REQUIREMENTS

The Painting Contractor shall adhere strictly to the safety requirements stated in the following paragraphs and shall also comply with any additional safety requirements furnished by the Owner Representative.

Scaffolding shall be completely rigid and stable. High scaffolding shall be tied to the structure being painted. Scaffolding shall be so placed that it will not interfere with the work of other crafts or the operation of the operating systems. The scaffolding shall be such that workers will be able to stand up with body and arms free of scaffolding or staging and structure being worked on.

Containers used on scaffolds shall be securely fastened to prevent them from being knocked off.

Where there is possibility of flammable gas in the atmosphere, all tools such as brushes, scrapers and chisels used to clean steel surfaces shall be of the non-sparking type

All oil or paint-soaked rags shall be stored in closed containers. Clothes, overalls, etc. shall be stored to prevent fire from spontaneous combustion.

Paint products shall be stored in a place specified by the Owner and in accordance with the paint manufacturer's instructions.

Positive ventilation shall be provided in areas where paints are mixed and thinned, and where painting is being done. Solvent drums shall be grounded, and containers receiving solvents shall be electrically bonded to the drums by a suitable cable and clamp.

Surface cleaning of hydrocarbon containing tanks, vessels and equipment that are in service shall be performed by water blasting with fresh water.

Use of sandblasting for surface preparation is not allowed.

14. INSPECTION

Painting Contractor shall advise client before commencing specific paint applications.

Owner shall have the right to inspect the paintwork at all stages and to reject any and all tools, instruments, materials, staging or equipment or work, which do not conform to the specification.

The acceptance or rejection of preparatory work and application IS the sole right of Owner or his authorized representative.

Each coat shall be checked by the inspector prior to the application of the next coat. Areas found to contain runs, over sprays, roughness, pinholes or other signs of improper application shall be repaired in accordance with the manufacturer's recommendations and this specification at Painting Contractor's expense.

Finished paintwork shall have the correct shade, degree of gloss and events and be free from tackiness after drying/curing and from cracks, holidays, runs, sage, wrinkles, patchy ness, brush marks or other defects that may be deleterious to the quality of the coating.

Prior final acceptance of completed work, a joint inspection shall be made by Painting Contractor and client and an agreed inspection report signed by both parties.

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Owner's representative shall be promptly notified in writing of any adverse conditions which could affect the quality of the coating application where either responsibility for the resultant coating or any remedial work entailed may be subject to dispute.

EPC Contractor to purchase all equipment required for quality control tests such as DFT and WFT measurement gauge, humidity meter, thermometer, roughness tester, surface contamination assessment, low voltage holiday detector, high voltage holiday detector, "pull-off" and "cross-out" adhesion detector and salt detector in accordance with specification approved by NISOC representative. Inspection procedure for shop painting of equipment shall be performed based on project's ITP (Level1).

15. QUALITY CONTROL AND TESTING

Painting Contractor shall submit to Owner for approval, his proposed quality control and testing procedures covering all phases of surface preparation and paint application as may be carried out in the shop and/or field respectively and associated procedures which define how control is established and maintained. The procedures shall form part of the "Quality Assurance Manual".

The quality control procedures shall be in the form of an inspection and test plan which references all test procedures, witness points, acceptance and rejection criteria, and frequency of testing and how control of quality is measured and maintained.

Tests shall ensure that the quality of the surface coating is in accordance with that specified and shall include, but shall not be limited to thickness testing, adhesion testing, holiday testing, abrasion testing, solvent testing, etc.

All dry film thickness given in project specification shall be strictly adhered to and shall be measured in accordance with SSPC-PA2. The maximum tolerance on dry film thickness for each coat shall be in accordance with recommendations of the paint manufacturer, which once established shall not be exceeded. The film thickness shall be checked with calibrated film thickness gauges, using the magnetic resistance or eddy currents principle, such as Elcometer, Microtest, Tinsley, etc., and following the procedures covered in SSPC-PA2. The equipment shall be calibrated at least twice daily in accordance with the manufacturer's recommendations.

In order to achieve the specified dry film thickness, frequent checks of wet film thickness shall be carried out during the paint application with film thickness gauges such as the Elcometer wheel or comb type.

In the event of the film thickness not meeting the specified requirements, additional coats(s) of the paint concerned shall be applied in compliance with the specified requirements.

The degree of curing of epoxy resin based paint systems shall be checked by the determination of the resistance of the coating to methyl ethyl ketone (MEK). After rubbing the coating for one minute with a rag soaked in MEK, the coating shall not be softened and shall resist scraping with a fingernail.

The adhesion of the primer to the Steel substrate and the inter-coat adhesion of the subsequent coats(S) and primer after curing shall be determined by alternative methods at the discretion of Owner.

Adhesion to the Steel substrate may be determined in accordance with X-cut tape tests described in ASTM D3359, Method A for specified film thickness in excess of 125 microns; and Method B for specified film thickness up to 125 microns.

Unless otherwise agreed, the criteria for acceptance of adhesion tests be a scale of 4A for ASTM D3359, Method A, and a scale of 4B for ASTM D3359, Method B.

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Prior to purchasing of any paint system, all related test in reference standard shall carried out in the presence of TPI and COMPNAY's representative. All certificates shall be submitted.

16. IDENTIFICATION

The Painting Contractor shall furnish a written record of surface preparation and protective coating system used on all major plant vessels equipment, machinery, piping and structures as applicable. This record" in addition to the requirements of NACE RP01-76 shall include.

- Date of surface preparation and protective coating applied.
- Manufacturer and the company paint number for each coat.
- If non-specification paint is used, use manufacturer's code number.

17. MARKING OF PIPING MATERIAL

If identification of piping is required by Owner, the Painting Contractor shall mark such piping with stenciled letters located along the main axis of the pipe and easily visible from the ground that indicated the piping designation system. Stenciled letters shall be 25mm high and in black. Letters shall be stenciled on the piping or piping insulation in the following locations:

- On each side of each valve within 150mm of the valve.
- Within 150mm from the point where the line terminates at vessel, equipment or other pipe.
- Within 150mm from the points where the line enters and leaves pipe runs.

18. FLOW DIRECTION

Flow direction should be stenciled at points significant for plan operation by black arrow symbol RAL 9005 (white arrow RAL 9002 in case of black color schedule).

19. GUARANTEE

The Painting Contractor and the paint manufacturer shall jointly guarantee the coating systems applied according to contract. During this period, no coating failures such as cracking, peeling, delimitation, loss of adhesion, etc. shall occur for the intended service conditions.