

**OIL & GAS DEVELOPMENT COMPANY LIMITED**  
**PROCUREMENT DEPARTMENT, ISLAMABAD**  
**FOREIGN SECTION A**

(To be completed, filled in, signed and stamped by the principal)

**ANNEXURE 'A'**

**Material** ELECTRIC MOTOR DRIVEN RECIPROCATING PUMPS  
**Tender Enquiry No** PROC-FA/CB/PROD/PUMP-4273-A/2019  
**Due Date**  
**Evaluation Criteria** FULL

**SCHEDULE OF REQUIREMENT**

Sr No	Description	Unit	Quantity	Unit Price (FOB)	Total Price (FOB)	Unit Price C & F BY SEA	Total Price C & F BY SEA	Deviated From Tender Spec. If Any
1	ELECTRIC MOTOR DRIVEN RECIPROCATING PUMP, CAPACITY 102 US GPM, DIS. PR. 48.3 BAR G, DETAIL SPECIFICATION ATTACHED AT ANNEXURE 'A'	Number	2					

Note:

1. **Bid bond and Bid Validity:** Pursuant to tender clause # 2.2, 11.4, 13 & 35.3.2, bid(s) must be accompanied by an upfront bid bond in the form of pay order/ demand draft or bank guarantee issued by scheduled bank of Pakistan or a branch of foreign bank operating in Pakistan, for an amount of **US\$ 4,000/-** (US\$ Four thousand only) or equivalent Pak Rupees, with technical bid and valid for 150 days from the date of opening of the bids. The bank guarantee must be issued in accordance with the format as per Annexure-C of the tender documents.
2. **Shipment from ACU member Countries:** In case of shipment from ACU member countries, the LC beneficiary should be of that particular country from where the consignment is being shipped.
3. **Terms and conditions:** Bidders are advised to carefully read all the terms and conditions of the Tender Document available at OGDCL web site in the master tender document.
4. **Summary rejection criteria:** - The summary rejection criteria at clause 35 of the tender document may also be examined carefully. Any bid not meeting the criteria spelled in the clause # 35 shall be summarily rejected without any right of appeal. The detailed tender document is available on OGDCL website as "Master set of tender document-Foreign".
5. **Payment Terms:** Clause No: 3 of Section-III (Part-B) i.e. Conditions of Contract "Special" of Tender Document has been amended and following will be the payments methods.
  - i. **Tender value less than or equal to US\$ 200,000:** Payment to the Contractor/ bidder in foreign currency shall be made by establishing in favor of the Contractor an irrevocable Letter of Credit (hereinafter called the L/C). 70 % Payment (s) under the L/C will be made for the FOB/ CFR / CPT (as the case may be) price of material of each shipment upon submission of the shipping documents. Balance 30% Payment will be released after receipt, inspection and acceptance of material.
  - ii. **Tender value more than US\$ 200,000:** Payment to the Contractor/ bidder in foreign currency shall be made by establishing in favor of the Contractor an irrevocable Letter of Credit (hereinafter called the L/C). 80 % Payment (s) under the L/C will be made for the FOB/ CFR / CPT (as the case may be) price of material of each shipment upon submission of the shipping documents. Balance 20% Payment will be released after receipt, inspection (in addition of pre-shipment inspection) and acceptance of material.

*Handwritten signature/initials*

**TERMS AND CONDITIONS:**

Sr. #	Description	Bidder's compliance
1	Original Authority letter of the manufacturer of the pump in favor of the packager/bidder. if it is not pump manufacturer mentioning OGDCL tender enquiry for compliance. Bidders have to quote the material from the manufacturers having manufacturing experience of min. 05 years.	
2	Original authority letter of Bidder in favor of local agent (if any).	
3	Bidder to provide the following information of the manufacturers. a- Company profile clearly mentioning the same type of goods for which bid is submitted. b- Establishment of company c- Manufacturing experience d- Website address: e- Postal address	
4	Bidder has to provide the supply record for the last 05 years in following format for the same type of pumps.. a- Name of the company to whom material supplied b- Year of supply c- Type of material supplied mentioning sizes and pressure ratings d- Amount of the consignment e- E-mail and contact No. of the purchaser. f- Provision of copies of at least 10 Nos. of purchase orders from the last 05 years projects as per provided supply record. g- Provision of copies of at least 10 Nos. of purchase orders from the last 05 years projects.	
5	Bids of any manufacturer, whose material malfunctioned after installation against any previous contracts awarded by OGDCL, shall be rejected.	
6	All the material (internal and external) has to be compliant to water analysis provided in the technical specs and should be NACE MR 0175 compliant. Bidder has to confirm that at the time of delivery, NACE MR 0175 certificate shall be provided for all the material.	
7	Bidder has to provide the valid following certificates of the Pump and Motor manufacturers only. a- ISO 9001:20008, b- ISO 140001:2004, c- BS-OHSAS 18001:2007 certificates.	
8	Bidder to provide the technical literature of pumps, motor, gear reducers and all the accessories required for pump package etc.	
9	Delivery period shall be Max-180 days after L/c Establishment C & F by sea Karachi.	
10	Bidder has to clearly mention in the technical bid for the Make and model of pump, motor, coupling, gear reducer, chemical injection pump and relief valve etc.	

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11	Drawings as per model of each item shall be provided for the verifications. The same drawings shall be presented to third party inspector at the time of inspection.	
12	Bidder has to confirm that third party inspection shall be carried out. Bidder must facilitate TPI company w.r.t. Scope of Work during inspection in all respect. Cost of TPI shall be borne by OGDCL. OGDCL has the right either to carry out TPI or not. Scope of work shall be shared after award of contract.	
13	Bidder to confirm that all the material shall be brand new and not refurbished.	
14	Bidder has to confirm that any material (If TPI Required) shall not be shipped until unless Third Party Inspection report is submitted and approved by the OGDCL.	
15	Bids inclusive of all the documents and correspondence shall be in English language. Other language shall be treated as irrelevant unless the certified English translation copies are provided.	
16	Bidder to confirm that material shall be packed prior to shipment in accordance to international code and standard.	
17	Bidder to confirm and provide all the information/documents mentioned in the data sheets of the material (attached here) in technical proposals.	
18	Any bidder/beneficiary/manufacturer originating from the country to whom trade is banned, shall be rejected without issuance of any clarification.	
19	Bidder has to confirm that quoted Pumps, Motors, Chemical Injection Pumps and relief valve along with all the accessories shall be in accordance to the attached technical documents and data sheets.	
20	Bidder to submit the detail drawing of package comprising of pump, motor, gear reducer according to the flow rates and discharge pressure required for the pump, safety reilive valve network in accordance to the requirements of the reciprocating pump package. Detail of gear reducer to be provided according to the required speed to the achieve the pumping parameters. Accordingly all the technical specs and drawings of all the package along with equipments to be submitted in the technical bid for evaluation.	
21	Bidder to confirm that civil drawings in all respect shall be provided to OGDCL for installation of pumping packages after award of contract and prior to supply of the material.	
22	Bidder has to provide the financial audit report of last 03 years along with technical proposal for pump manufacturer.	
23	Bidder to confirm the packager of the pumping package.	
24	Provision of complete details of civil drawings after award of Contract prior to delivery of pumps.	

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Sr. #	Description	Bidder's compliance
24	Bidder to confirm and provide all the names of the vendors of the installed equipment in the technical bid. All the manufacturer must have at least 05 years manufacturing experience. Any information required during Technical evaluation regarding this shall be provided by bidder.	
25	Bidder to comply all the terms and condition and TOR along with required docs in his technical proposal.	

**Bidder to fulfill the following form be the part of technical bid.**

Sr. #	Description	Bidder's compliance
1	Positive Displacement Pump: Make and Model	
2	Electric Motor: Make and Model	
3	Chemical Injection Pump: Make, Model and Type	
4	Flexible Coupling: Make and Model	
5	Gear Reducer: make and Model	
6	Relif valve: Make and Model	

*3/er*



# OIL & GAS DEVELOPMENT COMPANY LIMITED

5/148

## SPECIFICATION # 4946-SP-003

## POSITIVE DISPLACEMENT PUMP



CONSULTANTS:

Aug. 2018





### PETROCHEMICAL ENGINEERING CONSULTANTS

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<p>Doc. No. : 4946-SP-003</p>	<p align="center"><b>Specification For Positive Displacement Pump</b></p>	<p align="center">Revision No. 0</p>

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## 1.0 INTRODUCTION

OGDCL intends to set up Produced water Injection system at Sinjhoru plant. The primary objective of this project is to dispose of produced water in Injection well via PD pumps. Injection well is located 11.3 km away from plant premises.

## 2.0 OBJECTIVE



This specification along with the data sheets covers the minimum requirements for the design, manufacture, inspection and testing, painting, packing and supply of Positive Displacement Pumps. Compliance with the requirements of this specification does not relieve the VENDOR of furnishing Positive Displacement Pumps along with its accessories of proper design, meeting all the specified rated operating and service conditions. It is not the

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intent of COMPANY to deviate from good engineering practice. The absence of any specifications SHALL imply that the best engineering practices SHALL prevail, utilizing first quality workmanship and new materials where different standards are specified, the most stringent SHALL apply. The entire equipment shall be designed for the life of min. 20 yrs. In all respects.

### 3.0 DEFINITIONS

COMPANY	Oil and Gas Development Company Limited
CONTRACTOR/ PURCHASER	Party which carries out all or part of the design, Engineering and construction of the Project.
VENDOR/SUPPLIER	Successful bidders or Party/ies, which manufactures and/or supplies material, equipment and services to perform the duties as specified by CONTRACTOR in the scope of supply.
PROJECT	Sinjhoru plant produced water disposal
SHALL	Indicates a mandatory requirement.
SHOULD	Indicates a strong recommendation to comply with the requirements of this document.

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#### 4.0 ABBREVIATIONS

EPCC	Engineering Procurement Construction and Commissioning
TPIA	Third party inspection agency, as appointed by PURCHASER
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
RFQ	Request for Quotation
PWHT	Post Weld Heat Treatment
QA	Quality Assurance
QC	Quality Control
NDT	Non Destructive Testing
DDSR	Document Data Submittal Requirements
MTC	Mill Test Certificate



#### 5.0 CODES AND STANDARDS

##### 5.1 General



- All specifications and publications SHALL be the current issue on the date of purchase order and it SHALL be the VENDOR'S responsibility to comply with the same.
- Positive Displacement Pumps SHALL be designed and manufactured in conformity with the codes, specification listed below and with the equipment data sheets.

##### 5.2 International Codes & Standards (Latest editions shall apply)

- API

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- ~~API 674~~ Positive Displacement Pumps- Reciprocating.
  - API 675 Positive Displacement Pumps – Controlled Volume
  - API 670 Machinery Protection Systems.
  - API RP 520/521 Sizing, Selection and Installation of Pressure Relieving Devices in Refineries.
  - API 615 Sound Control of Mechanical Equipment for Refinery Services.
- **ASME**
  - ASME B1.1 Unified Inch Screw Threads.
  - ASME B1.20.1 Pipe Threads, General Purpose, Inch.
  - ASME Sec. VIII Div. I Rules for Construction of Pressure Vessels.
  - ASME Sec. II Materials.
  - ASME Sec. V Non Destructive Examination.
  - ASME Sec. IX Welding, Brazing and Fusing Qualifications.
  - ASME B31.3 Process Piping.
  - ASME B16.5 Pipe Flanges and Flanged Fittings.
  - ASME B16.20 Metallic Gaskets for Pipe Flanges-Ring Joint, Spiral Wound, and Jacketed.
- **ASTM** American Society for Testing and Materials.
- **ISO**
  - ISO 10474 Steel and steel products – Inspection documents.

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ISO 15664                      Acoustic – Noise Control Design Procedures for Open Plant.

ISO 9001:2008                Quality Management System.

• **NACE**

NACE  
MR0175/ISO15156            Petroleum & Natural Gas Industries - Material for use in H<sub>2</sub>S Containing Environment in Oil & Gas Production.

TM0284                        Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen-Induced Cracking.

• **AWS**

AWS A2.4                      Standard Symbols for Welding, Brazing and Nondestructive Examination.

AWS A3.0                      Standard Welding Terms and Definitions.

AWS D1.1                      Structural Welding Code.

• **WRC**



WRC 107                        Local Stresses in Spherical and Cylindrical Shells Due to External Loadings.

WRC 297                        Local Stresses in Cylindrical Shells Due to External loadings on Nozzles-Supplement to WRC Bulletin No. 107

• **AISC American Institute of Steel Construction.**

**5.3 Error or Omission**

The review and comments by COMPANY / COMPANY Representative on SUPPLIER's or its manufacturer's drawings procedures or documents SHALL only indicate acceptance of general requirements and SHALL not relieve the

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SUPPLIER of its obligations to comply with the requirements of this document and other referred documents. All deviations to this document, other referred document or attachments SHALL be brought to the knowledge of the COMPANY / COMPANY Representative in the bid. All deviations made during the design, procurement, manufacturing, testing and inspection SHALL be with written approval by the COMPANY / COMPANY Representative prior to execution of work. Such deviations SHALL be shown in the documentation prepared by the SUPPLIER.

#### 5.4 Conflicting Requirements



In the event of any conflict, inconsistency or ambiguity between these documents, referred documents, codes & standards referenced in the documents the SUPPLIER SHALL refer to the COMPANY / COMPANY Representative whose decision SHALL prevail.

#### 5.5 Order of Precedence

In case of conflict between these specifications, its associated specifications, data sheets and the codes and standards, the VENDOR SHALL bring the matter to the PURCHASER's attention for resolution and approval in writing. Should any conflict occur as a result of the application of these regulations, data sheets, specifications and standards, the order of precedence SHALL be as follows:

- Government Legislation
- Data Sheets/ Drawings
- Project Specifications
- Industry Standards

All deviations from the requirements of this specification, its attachments and thereferenced codes and standards SHALL be stated in the quotation. In the absence of such a statement, full compliance SHALL be assumed. Compliance by

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the VENDOR with the provisions of this specification does not relieve him of his responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions and / or local codes governing health and safety.

### 5.6 Reporting Procedure

A reporting and documentation system SHALL be agreed between the COMPANY and the SUPPLIER for the status of procurement, design, manufacturing, inspection, testing and shipment of the Positive Displacement Pumps to be supplied under this specification. SUPPLIER SHALL provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

### 5.7 Company's Intention

It is intention of the COMPANY to procure the Positive Displacement Pumps based on Data Sheets, P&IDs, this specification document and referenced document as mentioned in section 5.0. SUPPLIER SHALL be responsible to supply Positive Displacement Pumps, in view of the requirements as detailed in relevant Data sheets and specifications, procure material, perform mechanical design (SUPPLIER SHALL submit the package general arrangement drawings for COMPANY's approval prior to finalization of design), fabricate, paint, test and prepare for shipment. SUPPLIER SHALL also obtain approval from COMPANY to buy any component of the package. SUPPLIER SHALL also be responsible for all sub-SUPPLIER's coordination, data and other documents, provision of guarantees, provision of equipment and personnel for the trial assembly, and functional testing of complete package at SUPPLIER's works and packaging and delivery as specified in this document.

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### 5.8 Supplier Responsibility

The SUPPLIER SHALL be responsible for the complete design, manufacturing, supply, inspection and testing of Positive Displacement Pumps including full compliance with all applicable design codes and standards listed in Section 4.2, of this document, and with the requirements of the certifying authority, if applicable.

Any work or material found to be defective or which doesn't meet the requirement of this specification, datasheets, P&ID and other reference specifications SHALL be replaced by the SUPPLIER at his own expense.



### 5.9 Language and Units of Measurements

The governing language SHALL be English language. All other referred quantities (temperature, pressure, flow rate, etc.) SHALL be expressed as per datasheet.

### 6.0 REFERENCE DOCUMENTS

1. Specification for Painting and Surface preparation (4946-SP-003).
2. Specification for Motor (4946-SP-002).
3. Specification for Corrosion Inhibitor system (4946-SP-004).



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**7.0 SITE DATA**

The following table gives the site and environmental conditions applicable to the location and specific to design and sizing of equipment.

<b>DESIGN AND AMBIENT CONDITIONS</b>	
Design Maximum Ambient Temperature - °F/°C	120/48.89
Design Minimum Ambient Temperature - °F/°C	37/2.78

<b>CLIMATIC CONDITION</b> (As per data by Pakistan Metrological Department)	
Relative Humidity (minimum monthly average)	40
Relative Humidity (maximum monthly average)	80

<b>AREA CLASSIFICATION</b>	
Zone 1, Group IIA & Temperature Class T6	

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## 8.0 VENDOR'S SCOPE OF SUPPLY

### 8.1 General

For scope of Positive Displacement Pumps, reference is made to the Pump Data Sheet giving the details of Pump operating conditions and design requirements. VENDOR'S scope of supply includes engineering, design, procurement, manufacture, painting, inspection & testing and performance guarantee of pumps. The scope of supply for each pump package SHALL include, but not necessarily be limited to, the following:

- Positive Displacement Pumps as specified in the equipment data sheets 4946-PDS-001 and 4946-PDS-003.
- Electrical Motor with terminal boxes as specified as per specs : 4946-SP-004.
- Gear reducer as per speed requirement in accordance to the design/operating pumping parameters (if required).
- Flexible coupling & coupling guard (non -sparking type).
- Pulsation dampener
- Lubrication system as per API 674, API 675 with all skid mounted accessories.
- Chemical injection package including storage tank as per Data Sheet: 4946-SP-001.
- Common base frame with lifting lugs.
- All "On Base" pipe work, electrical & instrument cabling.
- Stainless Steel SS 316 Nameplate.
- All necessary instrumentation such as vibration and temperature monitoring equipment (if required) with junction box.
- Holding down bolts for mounting of the pump & motor.
- Anchor bolts.
- Inspection and testing.
- Painting and coating.
- Packing, marking, preservation, and transportation.
- VENDOR documentation.
- Special tools (if required).

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- Earthing lugs (2 nos. located diagonally opposite).
- Start-up and commissioning spares.
- Recommended spares for 2 years operation.
- Inspection & testing operation manual (which includes trouble shoot & maintenance manual) and performance guarantee of pumps.
- All relevant drawings and documents soft copies (CD's) and two sets of hardcopies.
- Equipment dossier which includes all test results MTC etc.
- Details of civil foundations as per package.

The requirements set out in this document SHALL not be construed to eliminate consideration of the manufacturer's standard design. The manufacturers standard design may be accepted, if found to be equivalent or superior to the requirements of these specifications. The VENDOR SHALL provide material, equipment, instrumentation and any other accessory items, over and above that specified herein, which is required to provide a safe, workable and efficient unit. The VENDOR is also required to provide a Mechanical Guarantee. Preferable Vendors for the pump are, national Oil Well USA, Weatherford USA or equivalent.



## 8.2 Exclusions

- Installation of the packages
- Pump foundation.
- Local start / stop push button.
- Motor starters.
- Power cabling to motor.

## 8.3 Interfaces

VENDOR SHALL provide a detailed schedule and description of all termination points including:

- Suction & Discharge flange connection size and rating.
- Motor terminal box, power terminal.

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- Earthing bosses.

## 9.0 DESIGN



### 9.1 General

Positive Displacement Pumps SHALL be designed, constructed, inspected and tested in accordance with API 674, API 675, equipment data sheets and this specification. The most stringent requirement SHALL apply. The equipment (including auxiliaries) SHALL be designed for a minimum service life of Twenty (20) years & 5-6 years of uninterrupted continuous operation. Pump shall be selected for speeds not exceeding those recommended by API Standards. Pump size shall be based on the full load rated speed of the driver. All pumps shall be designed to permit rapid and economical maintenance, particularly regarding packing and valves for reciprocating pump. Pumps shall be fitted to a structural steel skid with driver, coupling and non-sparking guard. All necessary auxiliary piping (for lubrication, sealing and flushing, etc.) shall be supplied and shall always be within the skid area. Piping shall comply with ASME B31.3. All piping terminations shall be valved and terminate with a flange connection at the skid edge. Pump and motor mounting surfaces on base plate supports and mounting pads shall be machined flat and in the same plane. Vendors to advise/confirm the maximum allowable nozzle loadings for the equipment in their bid.

### 9.2 Mechanical

#### 9.2.1 General

- Drain Connection

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All auxiliary connections to the pressure casing SHALL be fitted with flanged stubs, full penetration welded to the casing. No socket welds SHALL be provided. Pump casing drains SHALL be provided.

- **Lubrication**

Pump lubrication systems shall be manufacturer's standard with proven experience for the type, rating and application. Pump design shall ensure adequate lubrication of the crosshead pin and bearings for all operating conditions. An oil level sight glass shall be furnished as well as a calibrated oil dipstick on gear boxes. As a minimum, the following auxiliaries shall be furnished for the crankcase lubrication system of pumps rated above 75 kW (100 hp) and 7000 kPa (70 barg): an oil filter, startup pump, low oil pressure trip out feature, pressure gage on each side of the oil filter, thermometer, visible level gage on the oil sump, oil flow indicator and surge protection devices. Vendor shall provide lubrication systems required to protect the pump and shall clearly detail the lubrication system requirements in his bid proposal.



- **Nozzles, Flanges and Miscellaneous Connections**

Suction flanges shall be rated for discharge pressure. All necessary drains, cocks, special fittings and accessories shall be furnished and shall be steel. Inlet and outlet connections shall be flanged to ASME B16.5 unless approved otherwise by PURCHASER.

The Pump Vendor shall be responsible for providing acceptable method for venting, bleeding, draining and cooling the pump and its related equipment.

- **Base frame / Mounting Plates**

The material for base frames / mounting plates SHALL be as specified in the Pump data sheet. Mounting plates SHALL be circular and sufficiently rigid to support the pump and motor without distortion. Mounting plates will be

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supplied with the necessary bolts and gaskets. The circular mounting plate SHALL be drilled to ASME B16.5.

- **Drivers**

Electrical Motor Drivers The electric motor SHALL be designed in accordance with the LV Motor as per specification/data sheet.

- **Coupling and Coupling Guards**

The pump VENDOR SHALL supply pump coupling. Flexible all-steel couplings SHALL be provided for pump. Rigid all steel, axially adjustable, couplings SHALL be supplied for vertical pump with bearings integral with driver. Any exposed shaft and coupling SHALL be provided with removable metallic non-sparking guards for protection against injury to personnel. Aluminum is not acceptable as non-sparking material.

- **Nameplates**



VENDOR'S SHALL furnish a permanently attached corrosion resistant nameplate with the equipment.

- **Earthing boss, lifting lugs.**

The skid base frame SHALL be provided with 2 nos. earthing boss located diagonally opposite and lifting lugs for single lift.

### 9.2.2 Selection of Types

When a direct-acting pump is used, a low clearance volume type shall be considered for any application where the liquid is near its boiling point and for any service where the entrained gas is likely to enter the liquid cylinder. Where a wide range of capacity control is required, the following types of controls and/or pumps shall be supplied:

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Use of variable stroke or variable speed pumps. Provisions in the pump design shall be such that the stroke adjustment can be carried on while the pump is in operation.

### 9.2.3 Cylinder

The maximum allowable working pressure of the cylinder shall be at least 110% of the rated discharge pressure. Piston type liquid end cylinders shall be provided with liners. For piston diameters larger than 100 mm, the liner shall be flange and bolted to the cylinder, held in place by jack bolts, clamped or held in place by followers and set screws. Non-pressured liners shall seal against the cylinder with a gasket O-ring. Corrosion allowance for "liquid end pressure casing" shall not be less than 3 mm. Flanges that are not forged or cast integral with the cylinder shall be socket welded to the pump cylinder. Screwed and seal welded flanges are not acceptable. Connections shall be studed. Jackscrews, lifting lugs, eyebolts, guide dowels and alignment dowels shall be provided. When jackscrews are used as a means of parting contacting forces, one of the faces shall be relieved (counter bound or recessed) to prevent a leaking point or improper fit caused by marring. A clearance shall be provided at bolting locations to permit the use of sockets or box type wrenches. No tapped or flanged openings shall be furnished in the pumping chambers of the liquid end or in other highly stressed areas subject to cyclic loading, unless they are essential for pumping operation.

### 9.2.4 Pistons, Plungers and Piston Rods

A lantern ring shall be provided in the stuffing box for flushing or adding lubricant to the packing. Provision shall be made between the drive mechanism and the plunger liquid end to contain stuffing box leakage or to

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provide special liquid-end conditioning. Liquid end pistons shall be designed to meet the following requirements:



- Piston packing of the Snap ring type is preferred, but sectional rings with expander
- spring tempered to hold tension under maximum operating temperature will be considered.
- Design of pistons shall permit repacking without removing piston from the cylinder.
- Body and follower type pistons shall contain at least 3 rings of packing.
- Cast hollow pistons are not acceptable.
- If specified, 5 digit stroke counters of the non-resetting type shall be fitted.

Surfaces of plungers and rods in contact with packing shall be hardened or coated and shall have a minimum hardness of Rockwell C35. Plungers shall be secured to the rods or crossheads with nuts locked with cotter pins or with other fastening and locking methods suitable for the specified service conditions.

#### 9.2.5 Stuffing Boxes, Glands and Packing

Glands shall bolt to the stuffing box unless otherwise approved by PURCHASER. Gland studs shall pass through the holes (not slots) in the gland. If threaded glands are approved by PURCHASER, they shall be provided with gland pawls or equivalent devices to ensure positive locking. For fluid temperatures over 148 °C, stuffing boxes shall be extra deep, and shall be arranged for water cooling. Stuffing boxes shall be furnished with Lantern rings. Packing materials shall be provided and installed by the pump manufacturer. Unless the pump construction provides for alternate means of removal, all stuffing box lantern rings shall be drilled and tapped at two points





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to facilitate removal with threaded rods. All packing glands shall have non sparking metal bushings, positively secured.

### 9.2.6 Valves

Valve areas shall be resistant to the working fluid for maximum service life. Valve shall be ample to ensure velocities through the valves and parts consistent with the best practice for the particular service. Valve seats shall be re-machine able. Valves may be disc, ball, or wing guided as recommended by manufacture for each specific service. Recommendation shall be based on pressure, NPSH requirement, velocities, viscosity of fluid, and subject to purchaser's approval. Liquid velocities through discharge valves shall not exceed twice the velocity of liquid through the suction valves. In general wing guided valves are preferred, valves shall be arranged to eliminate gas pockets. Coil springs, if used on valves, shall be squared and ground to protect the plate against damage by the spring ends. The design shall provide sufficient free area through suction valves so that liquid velocities (obtained by dividing design capacity by free area) will not exceed the following:

- 1.07 m/s for pumping temperature 170°C or below, and maximum viscosity 57 cSt
- or below with more than 0.9 m excess NPSH available.
- 0.7 m/s for pumping temperature above 175°C or maximum viscosity above 57
- cSt, or less than 0.9m excess NPSH available.

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### 9.3 Process

Refer to equipment data sheets for rated operating conditions and the properties of liquid to be handled. The pumps SHALL be suitable for continuous operation and outdoor installation.

### 9.4 Piping



The supply, fabrication and erection of all pipe work SHALL comply with Specification for Piping Material Classes FS1403-SP-000-L-001 and ASME B31.3. All piping butt welds SHALL be 100% Radiographed. The suction & discharge, drain connection SHALL conform to ASME B16.5. Seal flush plans SHALL be as stated in the data sheets. Allowable Loads and moments SHALL be as defined in the API 674 and API 675. Screwed fittings are not allowed. All seal and lube oil piping fitting SHALL be butt weld type. All stainless steel lines SHALL be pickled and passivated. The arrangement of the equipment, including piping and auxiliaries, shall provide adequate clearance areas and safe access for operation and maintenance. All pumps shall be provided with separate vent connections unless the pump is of the self-venting design. Pulsation dampeners shall have flanged connections and shall be provided where necessary to smooth out pulsations. Preferred type is bladder type dampener

### 9.5 Instrumentation

Instrument selection, design and installation SHALL be provided if required

### 9.6 Electrical

Electrical selection, design and installation SHALL be provided if required

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## 9.7 Civil



### 9.7.1 General

All pumps SHALL be placed on concrete block foundation. VENDOR SHALL furnish loading data along with hold down bolts location plan & details of the complete package for foundation design.

### 9.7.2 Structural Steel Skid

The structural design of the skid(s) SHALL include the following minimum general requirements:

- Steel design SHALL be in accordance with BS 5950 or AISC.
- Bi-directional moment resistant frames SHALL be avoided.
- The minimum thickness of any structural steel plate SHALL be 6mm.
- The thickness of gusset and stiffener plates SHALL be 8mm minimum.
- The skid SHALL be designed to minimize field assembly and installation. All shopconnections to be designed as fully welded. Field welds SHALL be avoided, andfield connections SHALL be designed as bolted connections.
- The lifting lugs SHALL be located on the outside of the longitudinal perimeterbeams in order to minimize deflections. A transverse beam must be provided at lifting lug locations.
- Tie down lugs or brackets SHALL be welded to structural members of the skid(s)to allow tie down during transportation.
- Spreader bar, if required for lifting / handling of skid / Unit SHALL be supplied byVENDOR.

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### 9.8 Noise

The noise levels from each skid SHALL comply with the requirements of API 615 but SHALL not exceed 85 dBA at 1 m unless stated or otherwise approved by the COMPANY.



### 9.9 Nameplates

Nameplates shall be of Stainless steel. Nameplates shall be as per vendor standard.

The nameplate shall include the item number, process data, manufacturer data, rotation arrows, and year of build.

### 10.0 MATERIAL



- a) Materials used SHALL be in accordance with data sheets, this specification. Materials test certificates for ISO 10474 - 3.1b SHALL be submitted for all pressure parts and 2.2 for non-pressure parts, structural parts and spare parts.
- b) All the internal and external material shall be in compliance to cater the produced water composition specification mentioned in the attached data sheet 4946-PDS-001 for the whole life of the pump mentioned at para 2.0 of this specification.
- c) All pressure part materials SHALL be normalized and all plate materials SHALL have an under tolerance of "zero" millimeter.
- d) The VENDOR SHALL propose material specifications for Company Review and Approval.
- e) Cast iron shall not be used for liquid end pressure containing parts handling flammable liquids or toxic materials.

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- f) External parts subject to rotary or sliding motions (such as control linkage joints and adjusting mechanisms) shall be of corrosion-resistant materials suitable for the site environment.
- g) Sulphur content of all pressure part materials SHALL be kept less than 0.003%.
- h) Seals SHALL prevent the ingress of moisture and particulates.
- i) Gaskets SHALL be asbestos free.
- j) The use of sealing materials that can result in blockages / seizure of hydraulic components are strictly prohibited.
- k) The VENDOR SHALL ensure maximum standardization and interchangeability of Components.
- l) Unless otherwise required, all the internal parts in contact with the contained fluid SHALL be made of the same quality of material.
- m) All metallic materials exposed to hydrogen sulphide, including trace quantities, shall conform to but not be limited by the provisions of the latest edition of NACE Std. MR-01-75. Exceptions to this requirement may be:
  - The surface of piston rods or plungers in the packing contact area.
  - The valve components, where greater hardness has proven necessary. Vendor's proposals to use ceramic materials and coatings shall be submitted to Client for approval.

## 11.0 FABRICATION AND ASSEMBLY

Approval of all VENDOR drawings, weld procedures, calculations, etc. is required by the COMPANY and the certifying authority, where applicable, prior to the commencement of fabrication.

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## 12.0 SURFACE PREPARATION AND PAINTING



Surface preparation and Painting & Coating of the Positive Displacement Pumps and all the accessories SHALL be in accordance with Specification for Painting and Surface preparation (4946-SP-003).

## 13.0 INSPECTION AND TESTING REQUIREMENT

### 13.1 Quality Assurance

The VENDOR SHALL demonstrate that he operates a quality system in accordance with an internationally recognized standard such as ISO 9001:2008 or agreed equivalent standard, commensurate with the goods and services provided. The effectiveness of the quality system and the VENDOR'S compliance with it SHALL be subject to monitoring by COMPANY and in addition, may be audited by an agreed period of notice.

The format and outline content of the quality plan SHALL be agreed between VENDOR and PURCHASER, prior to order placement. The VENDOR SHALL submit with his tender an Inspection and Test plan specific to this scope of supply. Detailed quality plan, the scope of testing and the "hold points" SHALL be mutually agreed between the PURCHASER and the VENDOR during the technical bid submission. The VENDOR SHALL submit a quality control program for COMPANY'S review at the time of proposal. The VENDOR SHALL provide facilities for and cooperate with COMPANY and its designated authorized inspectors during manufacturing, assembly and testing. The VENDOR SHALL inform the COMPANY four (4) weeks in advance for preproduction meeting.



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**13.2 Pre-Inspection Meeting**

The COMPANY or Third Party Inspection Agency (TPIA) appointed by the PURCHASER and approved by COMPANY will initiate this meeting as required. The specification, inspection, testing and packing will be reviewed with VENDOR'S manufacturing and quality control personnel. The VENDOR SHALL provide a Quality Plan/ Inspection and Testing Plan for manufacturing. The plan SHALL cover all quality related aspects of each piece of equipment in the specification and SHALL indicate inspection points, review points and milestones where the inspector will examine the equipment. From this quality plan, COMPANY will establish an Inspection Schedule. At no time will inspection by VENDOR and/or his Third Party Inspector relieve the VENDOR of his quality control responsibilities.

**13.3 Inspection and Testing of Positive Displacement Pumps**

Inspection & testing of all the components of Positive Displacement Pumps SHALL be performed by a third party inspection agency appointed by PURCHASER. VENDOR SHALL provide a complete Inspection & Testing Plan for review by COMPANY/ TPIA. Inspection, testing and material certification SHALL be in accordance with the requirements of API 674 and API 675 codes and standards and also the requirements of the certification/ Approval Authority. In order to enable a proper scheduling of the inspection visits, VENDOR is requested to notify COMPANY'S Third Party Inspector at least two (2) weeks prior to the date of inspection. When components or services are obtained from Sub-VENDOR'S the COMPANY'S inspector and/or his agent reserves the right to inspect these items at the point of manufacture. It is the VENDOR'S responsibility to include COMPANY'S inspection and notification requirements in all sub-orders. VENDOR SHALL provide free access to his works and that of Sub-VENDOR'S for the



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authorized representative of COMPANY. All certification on the materials, shop test data, etc., SHALL be made available to verify that the requirements of the purchase order are being met. The VENDOR SHALL provide test certificates for all tests carried out on component equipment, as detailed in the Document and Data Submittal Requirements (DDSR) attached with Material Requisition. Test certificates SHALL be approved by TPIA or COMPANY'S Representative prior to dispatch and official certificates SHALL be forwarded within one week of test completion. If a pump fails to meet the specified duty, the number of tests SHALL be adjusted and agreed with COMPANY. Any increase in the scope of the test programme either due to the failure of the equipment to perform satisfactorily or its design SHALL be at the VENDOR'S expense. The pump performance testing SHALL be completed in accordance with API 674 and API 675 latest edition. A witnessed full functional test, simulating site operating conditions and including a noise test, SHALL be carried out on complete pump package.

If a pump fails to meet the specified duty, the number of test SHALL be adjusted and agreed with COMPANY. Any increase in the scope of the test programme either due to the failure of the equipment to perform satisfactorily or its design SHALL be at the VENDOR'S expense.

Prior to the test specified above, VENDOR SHALL perform individual component test in all package auxiliaries and components and the record SHALL made available to COMPANY. The acceptable Test Tolerances SHALL be as per API 674 and API 675. COMPANY reserves the right to witness further tests like hydrostatic test, running test, performance test, etc. in line with applicable codes and standards.





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### 13.4 Factory Acceptance Test

The PURCHASER reserves the right to visit the VENDOR'S premises to witness an acceptance test of the equipment and SHALL be given sixty working days' notice in writing of readiness for this Testing. Without prior approval of OGDCL load testing shall not be carried out. Test reports duly signed and stamped shall be provided with the consignment prior to shipment for OGDCL approval. OGDCL has the right to either witness the FAT/TPI or not at its own cost. If OGDCL arranges third party inspection. Supplier shall facilitate regarding provision of all the docs or else required by inspector. The equipment will be thoroughly tested by the VENDOR prior to the acceptance test. Prior to the start of the VENDOR'S testing, a detailed schedule of the tests SHALL be supplied to the PURCHASER. The acceptance test will check compliance with the specification and the VENDOR is to make available all necessary equipment and services for this test. Notwithstanding the above notice periods the VENDOR SHALL, following receipt of the purchase order submit to the PURCHASER a schedule identifying details of timing of design, construction and testing activities.

### 13.5 Third Party Inspecting Authority

The Third Party Inspection Authority (TPIA) SHALL be appointed by OGDCL (if deemed appropriate). TPIA SHALL be responsible for verifying that the Pump is designed, manufactured, inspected and tested in accordance with the requirements of this specification and all relevant applicable codes. TPIA SHALL verify that the Unit is manufactured, inspected and tested in accordance with specified requirements. TPIA SHALL resolve all technical queries raised by manufacturers, if necessary by reference to COMPANY. TPIA SHALL witness the performance of quality related activities, inspection and tests. TPIA SHALL review and approve specified quality verifying

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documentation before release of the Unit from the VENDOR'S work premises.

### 13.6 General Requirement



The VENDOR SHALL provide COMPANY and TPIA Inspector with at least 60 days' notice to witness tests run in both his shop and his sub-VENDOR'S shops. The VENDOR SHALL provide COMPANY and TPIA with reasonable access to his and his sub-VENDOR'S plant facilities in order to verify that equipment is manufactured and tested as specified. The VENDOR SHALL provide calibration certificates of testing instrumentation for review by the inspector prior to each test. The VENDOR SHALL provide weekly reports during procurement and fabrication phases indicating progress status.

### 13.7 Site Acceptance Test / Final Acceptance Criteria

After the mechanical completion and commissioning of the Positive Displacement Pumps, a site Acceptance Test SHALL be conducted at site in VENDOR'S presence to verify the performance of the unit. The final acceptance criteria for the package SHALL be in accordance with scope of supply in Section 7.0 and data sheets, applicable codes, standards and regulations as per Section 4.0.

### 13.8 Technical Integrity

The VENDOR SHALL be responsible for the technical integrity of the pumps, including: mechanical design, supply of material, manufacture, quality assurance, assembly, testing, performance and specified engineering services. All of these activities SHALL be in accordance with the scope of supply, this functional specification and data / interface information supplied

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by the PURCHASER. The VENDOR SHALL have single point responsibility for all aspects of the works, inclusive of all components subcontracted or purchased from other parties.

### 13.9 Deviation / Concessions



Weld repair of plate surface defects will not be permitted without COMPANY approval and SHALL be subject to an agreed repair procedure prior to work being carried out. Additionally COMPANY approval for any distortion correction procedure prior to applying the proposed corrective treatment is required. The Third Party Inspecting Authority SHALL not approve any deviations/ concessions from the requirements of the specification, codes without the specific approval of the COMPANY. The Third Party Inspecting Authority SHALL immediately notify the COMPANY of any deviation/ concession request from the manufacturer which contravenes the requirements of the design code or which, in the Third Party Inspecting Authority's opinion, makes the Unit unfit for it's intended purpose.

### 13.10 Material Testing & Certification Requirement

Unless otherwise specified, materials SHALL be subject to the following requirements:

All welding of pressure retaining parts SHALL receive 100% NDT. This SHALL be carried out after stress relieving, if required. Magnetic particle or dye-penetrant methods SHALL be used for surface inspection. Ultrasonic or radiographic inspection methods SHALL be used for sub-surface inspection.

Certification requirements SHALL be as follows:

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- Pressure containing parts such casing, impeller, wear rings, shaft and all bolting used for lifting SHALL be certified in accordance with ISO 10474, 3.1b.
- Non-pressure containing parts SHALL be certified in accordance with ISO 10474, 2.2.



The appointed TPIA SHALL review material test certificate during examination of items at VENDOR works as applicable Certificate SHALL be provided in accordance with material requisition Document and Data Submittal Requirements (DDSR) covering each item supplied. All certificates SHOULD be fully traceable to the item covered and SHALL be marked with the PURCHASER order number, item number and tag/part number. They SHALL be clearly legible, in the English language.

#### **14.0 SPARE PARTS**

VENDOR to provide a comprehensive listing of spare parts, recommendations covering Start-Up, Commissioning and two (2) years of Continuous equipment's Operation. Cost of spare parts shall not be the part of financial evaluation. OGDCL has the right either to purchase all the recommended parts or selected items are purchased.

#### **15.0 GUARANTEE**



VENDOR SHALL be fully responsible for all equipment supplied by him including bought out items. All the equipment SHALL be fully guaranteed for a period of twelve months after commissioning or eighteen months after date of supply, whichever comes first. The VENDOR SHALL provide all Certification for the equipment and SHALL ensure that, dimensional compatibility, shaft system critical speeds, vibration, noise levels and

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acceptability of pipe loads are within the relevant specification limits. Provision of all data necessary for the design of lifting equipment, support and structures is required. **VENDOR SHALL** guarantee all equipment as being suitable for the design conditions and service fluids stated on the data sheets. Guarantee from Bidder **SHALL** cover mechanical workmanship and performance of the complete pump package. **VENDOR SHALL** have the final and total responsibility for the design and performance of all equipment's supplied under this specification. **VENDOR SHALL** provide a performance guarantee for the pumps.

**16.0 PREPARATION FOR SHIPMENT AND PACKING**

All items **SHALL** be suitably protected against damage during shipment and storage. On completion of inspection and tests, equipment **SHALL** be thoroughly cleaned and dried internally and externally and prepared for shipment. The package **SHALL** be adequately protected against corrosion and mechanical damage during shipment to plant site and outdoor storage for period up to one year. **VENDOR SHALL** consider transit route to site and pack accordingly. If dispatched in pieces, **VENDOR SHALL** submit the procedure of assembling for **PURCHASER'S** information. **VENDOR SHALL** provide recommended procedures and checklists for commissioning, start-up. All special tools and calibration tools required for assembly and commissioning **SHALL** be in **VENDOR'S** scope of supply. All flanges **SHALL** be covered with metal covers, soft rubber gaskets and held by at least four (4) bolts. Other openings **SHALL** be taped closed. Threaded connections **SHALL** be capped or plugged for thread protection. Any external components, which may be subject to damage during transit and are not easily protected, **SHALL** be removed and packaged separately, to the equipment, for shipment with all openings plugged. Extent of loose supplied items to be marked on equipment drawings. The pumps **SHALL** be sealed

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closed and contain bags of desiccant to prevent rust. Auxiliary piping connections SHALL be tagged or marked for identification in the field. Each package SHALL contain lists of contents; one list inside and one list outside of the package. The package SHALL have external identification corresponding to the order number. All loose items shipped with the equipment SHALL be tagged with the order number and item identification. Startup / Commissioning spare parts SHALL be identified separately. The equipment SHALL be delivered with one copy of the Installation, operation and maintenance manuals.

## 17.0 SITE SUPERVISION AND COMMISSIONING REQUIREMENTS

The VENDOR SHALL include for the services of a competent and experienced field engineer/ supervisor for the installation/ modifications, testing and commissioning of the equipment covered by this specification. The PURCHASER reserves the right to determine the timing and amount of start-up assistance required. Commissioning of the package shall be carried out by the suppliers qualified engineer. OGDCL shall provide only boarding/lodging to the commissioning engineer only.

### 17.1 Start-up and Commissioning Support

The VENDOR SHALL also be responsible for providing Start-Up and Commissioning Support at site at its own expenses. Also, commissioning team shall train the OGDCL manpower for adequate operation of the pumps in all respect for smooth operation. This information SHALL include a list of personnel, required crew size, planned duration of in-services and a description of all work to be performed (if contract is awarded).



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### 17.2 Availability / Reliability

The design life and overall availability / reliability of the equipment SHALL be demonstrated by the VENDOR with bid. This SHALL be by reference to the previous experience with proven designs which have operated in the field for at least three years with only planned outages for maintenance / replacement of normal wearing type components. VENDOR SHALL design the equipment for 20 years operating life. In making assessments of availability / reliability, the VENDOR SHALL estimate repair time. VENDOR may assume that the spares holdings are in accordance with his submitted recommendations unless otherwise stated. VENDOR may also neglect any delay caused by factor not directly related to the package in questions unless a basis for estimating such delays is provided. In cases of failure modes, which may have a significant contribution to the overall unavailability, the VENDOR may be required to demonstrate that the assumed repair time can be achieved.

### 17.3 Operator Training

VENDOR SHALL be responsible for providing all necessary materials including any videos, if required, to adequately train the COMPANY'S operators for operations and maintenance of equipment supplied by the VENDOR. VENDOR SHALL also provide, if necessary, qualified personnel for operator training, Training SHALL cover basic theory equipment, construction operating procedures, maintenance procedures and control system training as a minimum.

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## 18.0 DOCUMENTATION

### 18.1 Data Required with Bid

VENDOR SHALL provide the following along with the bid:

- Comments / Deviations / Exceptions taken by the VENDOR with respect to Codes, Standards and Regulations SHALL be explained with technical justification for PURCHASER'S evaluation.
- Functional description.
- Reliability / Availability information and figures.
- ✓ General Arrangement Drawings of the Pump with accessories.
- ✓ Performance curves for Pump & Drive system showing the selection criteria.
- ✓ Completed Data Sheets with Process Guarantee.
  - Detailed scope of supply including detailed material.
  - Pump weight data. Erection weight operational weight, maximum weight.
  - Foundation Loading Plan to indicate the critical loads at each support for all loadcases.
  - Schedule of Materials of Construction.
  - Proposed manufacturing/ delivery schedule.
  - Proposed Quality Assurance/ Safety Plan.
  - Proposed Surface treatment.
  - Typical Inspection and Test Plan.
  - Certificates of conformity and declarations of compliance for equipment used in hazardous areas as specified.
  - Recommended start-up and Commissioning spare list
  - Recommended 2 years' Operating spares.
  - List of references.



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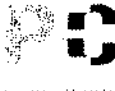
- List of proposed major Sub-CONTRACTOR / VENDOR'S.
- Utility requirement and Consumption.
- VENDOR assistance, support facilities in Pakistan.

## 18.2 Drawings and Documents


The drawings and documents to be submitted after the Purchase Order SHALL be in accordance with applicable API Standard (i.e. API 674, API 675) and Document and Data Submittal Requirements (DDSR). The VENDOR drawings SHALL be reviewed and approved by COMPANY, against the Purchase Order. The approval by COMPANY does not signify compliance with the purchase order. It SHOULD be noted that review by the COMPANY is for quality assurance purpose only, assuming that VENDOR is technically responsible for all technical aspects of design checking. The VENDOR is responsible for checking of compliance with the relevant documents like this specification, applicable codes and COMPANY standards. Drawing detailing package envelope including installation and maintenance requirement and interface connections SHALL be supplied by VENDOR.

## 19.0 HEALTH SAFETY & ENVIRONMENT

The VENDOR SHALL be responsible for ensuring that the goods and services supplied meet all applicable national and international codes/ regulations on health, safety and environmental requirements.

CLIENT		SINJHORO PLANT PRODUCED WATER DISPOSAL				CONSULTANT					
						DOC. TITLE		DATA SHEET FOR WELL INJECTION PUMP (RECIPROCATING PUMP)			
						DOC. NO.		4945-PDS-001		REV 3	
						APPLICABLE TO:		<input type="radio"/> PROPOSAL <input checked="" type="radio"/> PURCHASE <input type="radio"/> AS BUILT		UNIT	
FOR		OIL & GAS DEVELOPMENT COMPANY LIMITED				NO. OF PUMPS REQUIRED		2			
SITE		SINJHORO PLANT				TYPE		PD PUMP			
SERVICE		PRODUCED WATER				SERIAL NO.					
MANUFACTURER						ITEM TAG NO		P-01 A/B			
NOTE:		<input type="radio"/> INDICATES INFORMATION TO BE COMPLETED BY PURCHASER <input checked="" type="checkbox"/> BY MANUFACTURER									
<b>GENERAL</b>											
NO. MOTOR DRIVEN		2		OTHER DRIVER TYPE							
PUMP ITEM NO'S				PUMP ITEM NO'S							
MOTOR ITEM NO'S				DRIVER ITEM NO'S		GEAR ITEM NO'S					
MOTOR PROVIDED BY				DRIVER PROVIDED BY		GEAR PROVIDED BY					
MOTOR MOUNTED BY				DRIVER MOUNTED BY		GEAR MOUNTED BY					
MOTOR DATA SHEET NO				DRIVER DATA SHEET NO		GEAR DATA SHEET NO					
<b>OPERATING CONDITION</b>					<b>LIQUID PROPERTIES</b>						
CAPACITY (USGPM)					TYPE OR NAME OF LIQUID						
Maximum: 102 Normal					Produced Water + Condensate traces						
DISCHARGE PRESSURE (BARG)					PUMPING TEMPERATURE, °F						
Maximum: 48.3 Normal					Minimum: 38 Maximum: 100						
SUCTION PRESSURE (BARG)					SPECIFIC GRAVITY						
Maximum: -0.18 Normal					Minimum: Maximum: 0.99						
DIFFERENTIAL PRESSURE (BARG)					VISCOSITY						
Maximum: 48.5 Normal					Minimum: 0.55 Maximum: 0.65						
NPSH AVAILABLE (m)					CORROSIVE / EROSION AGENT						
Without Accelerated Head: 5					Chloride & dissolved $Cl_2$						
					CHLORIDE CONCENTRATION (PPM)						
					LIQUID: <input checked="" type="radio"/> TOXIC <input type="radio"/> FLAMMABLE <input type="radio"/> OTHER						
					ACTUAL VTS						
<b>PROCESS DATA</b>					<b>SITE AND UTILITY DATA</b>						
Fluid: Produced water					LOCATION: <input type="radio"/> INDOOR <input checked="" type="radio"/> OUTDOOR						
Density: lb/ft <sup>3</sup> 61.8					<input type="radio"/> HEATED <input type="radio"/> UNHEATED <input type="radio"/> UNDER ROOF						
Viscosity: cP 0.61					AREA CLASSIFICATION: Zone 2, Group IIA & Temperature Class T4						
Pump Temperature: °F 100					SITE DATA						
Suction Pressure: psia					RANGE OF AMBIENT TEMPERATURE: MIN/MAX 0 / ± 50 °C						
Discharge Pressure: psia					UNUSUAL CONDITIONS						
Differential Pressure: psia					<input checked="" type="radio"/> DUST <input type="radio"/> SALT ATMOSPHERE <input type="radio"/> FUMES						
Vapour Pressure: psi 0.94					<input type="radio"/> OTHER						
Design Temperature: °F					UTILITY CONDITIONS						
NPSHr: ft Vendor to advise minimum requirement					ELECTRICITY    DRIVERS    HEATING    CONTROL    SHUTDOWN						
Corrosion Allowance: 6 mm					VOLTAGE: 440						
					HERTZ: 40						
					PHASE: 3						
<b>CONSTRUCTION</b>					<b>DRIVER</b>						
CONNECTION		SIZE	ANSI RATING	FACING	POSITION	MOTOR MANUFACTURER					
SUCTION		4"	150#	RF	bottom (VTC)	MOTOR TYPE					
DISCHARGE		4"	300#	RF	top (VTC)	FRAME NO					
TYPE		<input type="radio"/> DIAPHRAGM <input checked="" type="radio"/> PLUNGER			TYPE						
Plunger Diameter (mm)		VTS			<input checked="" type="radio"/> CONSTANT SPEED <input type="radio"/> VARIABLE SPEED						
Material - Duplex Stainless Steel (VTS)		No Req			Power (kW) 59 KW (NOTE-1)						
VALVE/FEED TYPE		SUCTION Plate (VTC)			VOLTS 440 HERTZ 50						
NUMBER		DISCHARGE Plate (VTC)			RPM VTS PHASE 3						
		VTS			OTHER						
					<b>APPLICABLE SPECIFICATIONS</b>						
					<input checked="" type="radio"/> API 675 POSITIVE DISPLACEMENT PUMPS - CONTROLLED VOLUME						
					<input type="radio"/> GOVERNING SPECIFICATION ( IF DIFFERENT )						
					<b>OTHER</b>						
RATED CAPACITY (USGPM)					CONTROL TYPE						
HYDRAULIC KW					<input type="radio"/> MANUAL <input type="radio"/> REMOTE <input type="radio"/> PNEUMATIC						
EFFICIENCY, %					<input checked="" type="radio"/> AUTOMATIC <input checked="" type="radio"/> LOCAL <input checked="" type="radio"/> ELECTRONIC						
ACTUAL HORSE POWER, KW					SHIPMENT						
MAXIMUM PRESSURE (BARG)					<input type="radio"/> DOMESTIC <input type="radio"/> EXPORT <input type="radio"/> EXPORT BOXING						
HYDRO TEST PRESSURE (BARG)					<input type="radio"/> OUTDOOR STORAGE MORE THAN 6 MONTHS						
PLUNGER SPEED (strokes/min) (VTS)					LUBRICATION FLUID						
DIAMETER (mm) (VTS) STROKE LENGTH (mm) (VTS)					<input checked="" type="radio"/> CRANKCASE <input type="radio"/> INTERMEDIATE						
					<input checked="" type="radio"/> HYDRAULIC FLUID						
<b>QA INSPECTION AND TEST</b>					VENDOR FURNISHED RELIEF VALVE						
<input type="radio"/> COMPLIANCE WITH INSPECTORS CHECK LIST					<input checked="" type="radio"/> INTERNAL						
<input checked="" type="radio"/> CERTIFICATE OF MATERIALS					<input type="radio"/> EXTERNAL						
<input type="radio"/> FINAL ASSEMBLY CLEARANCE					NAMEPLATE UNITS						
TESTS					<input checked="" type="radio"/> US CUSTOMARY						
HYDROSTATIC					<input type="radio"/> SI						
STEADY STATE ACCURACY											
LINEARITY											
10-07-19		3	RE-ISSUED FOR REVIEW				SHR	BA	AJ		
07-09-18		2	ISSUED FOR REVIEW				RK	NWS	AJ		
23/5/2018		1	ISSUED FOR REVIEW				RK	NWS	AJ		
Date		Rev	Description				PREP.	CKD	APPR		

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	<b>SINJHORO PLANT PRODUCED WATER DISPOSAL</b>		<b>CONSULTANT</b>	
	<b>DOC. TITLE</b>		<b>DATA SHEET FOR WELL INJECTION PUMP (RECIPROCATING PUMP)</b>	
	<b>DOC. NO.</b>		4946-PDS-001	REV 3

Produced Water Analysis	
Parameters	Value
Conductivity	>90,000 µs/cm
pH	5.8
Chloride (as Cl)	46085 ppm
Iron	78 ppm
Zinc	1.03 ppm
Free Chlorine	0.62 ppm
TDS	>60,000 ppm
TSS	64



**NOTES**

1. Vendor shall provide motor of 59 KW as proposed in the datasheet.

10-07-19	3	RE ISSUED FOR REVIEW	SHR	BA	AJ
07-08-18	2	ISSUED FOR REVIEW	RK	NWS	AJ
23/5/2018	1	ISSUED FOR REVIEW	RK	NWS	AJ
Date	Rev	Description	PREP.	CKD	APPR

3/9/19

44/148

CLIENT		SINHORO PLANT PRODUCED WATER DISPOSAL				CONSULTANT	
						DOC. TITLE	
		DOC. NO.		4946-PDS-003		REV. 1	
							

S.No.	DESCRIPTION		PRV-001A		PRV-001B	
1	SERVICE		PRODUCED WATER		PRODUCED WATER	
2	LINE NO. / VESSEL NO.		4"-PW-012-B1		4"-PW-011-B1	
3	FULL NOZZLE / SEMI NOZZLE		FULL		FULL	
4	SAFETY OR RELIEF		RELIEF		RELIEF	
5	CONV. / BELLOWS / PILOT OP		CONVENTIONAL		CONVENTIONAL	
6	BONNET TYPE		CLOSED		CLOSED	
7	SIZE INLET	OUTLET	1.5"	3"	1.5"	3"
8	FLANGE RATING		300 X 150		300 X 150	
9	TYPE OF FACING		RTJ x RF		RTJ x RF	
10	BODY AND BONNET		ASME SA-216,GR.WCB CARBON STEEL		ASME SA-216,GR.WCB CARBON STEEL	
11	NOZZLE AND DISC		SS316L		SS316L	
12	GUIDE AND RINGS		SS316L		SS316L	
13	SPRING		ALUMINISED C.S		ALUMINISED C.S	
14	LIFTING GEAR-TYPE		REQUIRED		REQUIRED	
15	TEST GAG		REQUIRED		REQUIRED	
16	CAP SCREWED OR BOLTED		SCREWED		SCREWED	
17	TEST CONNECTION		YES-CARBON STEEL		YES-CARBON STEEL	
18	MANUAL BLOWDOWN		YES-CARBON STEEL		YES-CARBON STEEL	
19	BACK FLOW PREVENTER		NO		NO	
20	CODE		ASME SEC VIII / API RP-520-521		ASME SEC VIII / API RP-520-521	
21	LEAKAGE CODE		ANSI / API 527		ANSI / API 527	
22	SIZING BASIS		BLOCK DISCHARGE		BLOCK DISCHARGE	
23	FLUID		PRODUCED WATER		PRODUCED WATER	
24	FLUID STATE		LIQUID		LIQUID	
25	SPECIFIC GRAVITY		0.96-0.99		0.96-0.99	
26	OPER. PRESS (psig)	SET PRES (psig)	700	720	700	720
27	OPER. TEMP. (°F)	MAX TEMP. (°F)	80-120	150	80-120	150
28	COLD BENCH TEST PRESSURE		VTS		VTS	
29	% ALLOWABLE OVERPRESSURE		10%		10%	
30	OVERPRESSURE FACTOR		N/A		N/A	
32	FLOW MAX		-		-	
33	VISCOSITY cP		0.6		0.6	
34	BACK PRESSURE		ATMOSPHERIC		ATMOSPHERIC	
35	DISCHARGE COEF Kd		0.65		0.65	
36	CHANGE OF STATE COEF C		VTS		VTS	
37	P&ID NO.		4946-PID-002		4946-PID-002	
38	CALC AREA SQ IN.		-		-	
39	SELECTED AREA SQ IN.		-		-	
40	ORIFICE DESIGNATION		G		G	
41	MANUFACTURER		-		-	
42	MODEL NUMBER		VTS		VTS	

NOTES:

1. VENDOR TO CONFIRM THE SUITABILITY OF THIS MODEL FOR THE REQUIRED SERVICE.

2. VTS-VENDOR TO SPECIFY OR CONFIRM

Rev.	Date	Description	Prepared	Checked
1	24/12/2018	Re-Issued For Review	SOH	BA Aj
0	08/03/2018	Issued For Review	RK	NWS Aj



# OIL & GAS DEVELOPMENT COMPANY LIMITED

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## SPECIFICATION # 4946-SP-004

### ELECTRIC MOTOR


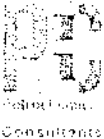
CONSULTANTS:

Aug. 2018





### PETROCHEMICAL ENGINEERING CONSULTANTS

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	<p style="text-align: center;"><b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b></p>	 <p style="text-align: right; font-size: 2em; font-weight: bold;">46/146</p>
<p>Doc. No:4946-SP-004</p>	<p style="text-align: center;"><b>SPECIFICATION FOR ELECTRIC MOTORS</b></p>	<p style="text-align: right;">Revision No. 0</p>

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	<b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b>	 Petrochemical Consultants
Doc. No:4946-SP-004	<b>SPECIFICATION FOR ELECTRIC MOTORS</b>	Revision No. 0

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## 1.0 GENERAL

### SCOPE

This specification covers the general requirements for design, manufacturing, and testing of the Electric motors to be used for OGDCL Sinjhoru Plant Produce Water Disposal system. Bidder to evaluate and specify the power requirement for the complete package having positive displacement plunger pumps, Chemical injection pump (mechanical drive taken from pump shaft) or any this required.



## 2.0 CODES AND STANDARDS

Design, manufacturing, test and inspection, material selection shall conform to the following IEC, BS and other standards:

- NFPA 70
- API Recommended Practice 500 A, B & C.
- Relevant British Standard Specifications and Codes of Practice.
- IEC Publications
- CENELEC Standards.
- The Institute of Petroleum -- Model Code of Safe Practice Electrical.
- The Institution of Electrical Engineers, Regulations for Electrical Installations.
- Institute of Electrical and Electronic Engineers (IEEE)
- International Organization for Standardization (ISO)
- National Association of Corrosion Engineers (NACE)
- American National Standard Institute (ANSI)

It shall be the Contractor / Manufacturer's responsibility to be, or to become, knowledgeable of the requirements of these standards and codes. Any changes or alternations to the equipment to make it meet standards and codes

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	<b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b>	
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requirements shall be at the expense of the manufacturer.

All standards, regulations and codes of practices used shall be of latest issues at the date of contract award. The Contractor shall be responsible for the availability of the above mentioned specifications/ publications, standards and codes of practices and any other relevant documents and shall collect these documents on its own.

The Contractor shall make sure that these documents are available all times and shall be presented to COMPANY on request.

#### **ORDER OF PRECEDENCE FOR DOCUMENTS**

- Country laws and regulation
- Project scope of work, specifications and drawings.
- IEC and internationally recognized standards

#### **3.0 SERVICE CONDITIONS**



For environmental condition, refer Design Basis Document.

#### **4.0 DESIGN AND CONSTRUCTION**

##### **Design**

- Motors shall be of three phase squirrel caged motor, and shall comply with the requirements of above standards unless otherwise specified. Motors shall be designed for duty type S1 and be suitable for direct on line starting unless otherwise specified.
  - Motors shall have IEC frame size in accordance with IEC 60072-1 and 60072-2.
  - Motor shall be 400VAC / 50Hz / 3-phase and safety factor of 1 or 1.15.
-



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- Motor design ambient temperature shall be 50 degC (122 degF).
- Motors shall be designed for a minimum of 25,000 hours continuous operation without requiring maintenance.
- The minimum design life time of motors shall be 20 years.
- Vendor shall only quote motors which have already been successfully type tested in accordance with the relevant IEC standards. Type test reports shall be made available, on Company's request with the bid.
- Motors shall be suitable for continuous operation at full load rating under a combined variation of the following voltage and frequency as per Para. 1.2.3 of IEC 60034-1:

Voltage fluctuation                     $\pm 10\%$  of rated voltage

Frequency fluctuation                 $\pm 2\%$  of rated frequency

- The moisture proofing, anti-corrosion protection and/or anti-tropical protection shall be applied for the motor winding.
- The torque - speed characteristics shall be adequate for starting the driven load under the most arduous conditions specified, e.g. open pump discharge valve, at 80% rated voltage. The accelerating torque at any speed and 80% rated voltage shall be not less than 10% of the rated full load torque.
- The specified motor shall be designed to apply re-acceleration operation for about 0.5sec voltage dip and re-starting operation about 1sec power failure.

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- The starting current at full voltage shall not exceed 700% of rated current for LV motors, 600% of rated current for HV motors.
- Motors shall be capable of starting three (3) consecutive times starting from rated ambient temperature and two (2) consecutive times from rated operating temperature. Motors rated above 375 kW (500 hp) that have been started under the above mentioned conditions shall not be restarted for a minimum of one hour.
- The motors shall be designed to operate for a periods of not less than 5 minutes at a voltage of 25% below the rated voltage at rated frequency without injuries overheating.
- Vibration severity requirements shall comply with IEC 60034-14 grade N.
- The motor rated voltage, power range, phase and frequency shall be 400VAC, 3-phase, 50 Hz.

## 5.0 CONSTRUCTION



### TYPE OF VENTILATION & COOLING

The motors shall generally be of totally enclosed fan cooled type. The direction of airflow shall be such that air is not drawn from the direction of the driven equipment. It is VENDOR responsibility to ensure and propose suitable cooling mechanism for enclosed motor.

#### Type of enclosure



Enclosure of motors shall generally be of the totally enclosed fan-cooled type (TEFC). Totally enclosed CACA design is also acceptable for large capacity motors, if TEFC type is not practicable. The degree of protection shall be of IP55 or above for outdoor and IP31 for indoor installation.

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Full details of cooling system shall be submitted at the bid stage for approval. The motors for use in explosive gas atmospheres shall be of the following types of construction depending on the classifications of the hazardous locations in which they are to be installed:

- (a) Motors and associated enclosures and skid/off-skid junction boxes shall be "Explosion Proof" for Class I, Division 1 hazardous areas. In case of Zone based system, these shall be "Flame Proof" Eexd for Zone-1&2 and installation in Zone-0 system shall be avoided.
- (b) Motors and associated enclosures and skid/off-skid junction boxes in Class I, Division 2 hazardous areas shall be certified for Class I, Division 2 hazardous areas. In case of Zone based system, these shall be suitable for installation in equivalent zone based system.
- (c) Accessories or parts of the motor with make and break contacts (e.g. temperature switch, pressure switch) or sliding contacts shall be "Explosion Proof" for Class I, Division 1 and for Class I, Division 2 hazardous areas. In case of Zone based system, these shall be "Flame Proof" Eexd for Zone-1 & EExe/EExd for Zone-2.
- (d) Where motors are used in Zone 1 or Zone 2 or Class I, Division 1 and Class I, Division 2 hazardous locations, non-sparking materials shall be used for the cooling fan of the motors.
- (e) For motors to be installed in hazardous areas, the motors and all auxiliary electrical equipment mounted on the motor shall be certified for use in hazardous areas mentioned above.
- (f) Equipotential bonding straps shall be provided between screwed bosses on the component parts of the enclosures. These straps shall be fitted symmetrically to the motor axis, be as short as possible and adequately sized for current carrying capacity and physical strength.
- (g) The motors to be installed in non-hazardous area shall be of the weather


	<p style="text-align: center;"><b>SINJHOLI PLANT PRODUCE WATER DISPOSAL</b></p>	
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protected type.

- (h) Enclosures for the motors shall be designed to prevent the entrance of liquids or solids through any openings such as air intakes, air outlets, enclosure joints or shaft extensions, and the entrance of moisture and dust through the ventilating system to the enclosure shall be minimized. Openings shall be suitably screened to prevent the entrance of harmful material
- (i) When motors are vertically mounted with the driving end shaft up, they shall be of "IMVU" (Foot mount/Vertical/Shaft-up) type and provided with a slinger plate on the driving end shaft to prevent water from entering the motor housing along the shaft. The construction of the foot mount motors shall prevent the buildup of water around the upper shaft bearing. The motors shall have threaded drain plugs in the lower end to allow removal of moisture. The plugs shall be easily removable at the construction site.
- (j) Vertical mount (shaft up) motors for outdoor use shall have a drip shield over the fan.
- (k) Frames shall be constructed from cast iron or fabricated steel

### ROTORS

- a) Rotors and external fans shall be dynamically balanced. Balance weights, if fitted, shall not be of lead or similar ductile material, and the rotor design shall allow for the addition of balancing weights.
- b) The bars of rotors shall be brazed or welded to the short-circuiting rings, unless the bars and rings of the cage are manufactured as a solid unit.

	<p style="text-align: center;"><b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b></p>	<p style="text-align: center;"><b>PEC</b> Petrochemical Engineering Consultants</p> <p style="text-align: right; font-size: 2em;">53/148</p>
<p>Doc. No:4946-SP-004</p>	<p style="text-align: center;"><b>SPECIFICATION FOR ELECTRIC MOTORS</b></p>	<p style="text-align: right;">Revision No. 0</p>

- c) Each motor shall generally be provided with a coupling key on the motor shaft.

#### **INSULATION CLASS**

- d) 400V and below:

Motor design ambient temperature shall be 50 degC (122 degF) for which VENDOR to ensure the compliant.



Minimum acceptable insulation Class shall be Class F but due consideration shall be given to above mentioned design ambient condition requirements.

#### **NOISE LEVEL**

Noise level of motors shall comply with the specific noise control requirements and not exceed 85dBA at 1m. Noise levels shall meet as a minimum of the requirements of IEC 60034-9

#### **BEARING AND LUBRICATION**

- a) Grease or oil lubricated bearings shall be used for random wound motors.
- b) Bearing housings for grease lubricated bearings shall be provided with exterior fill and relief plugs in tapped holes. Relief plugs must be large enough to relieve bearings without grease getting into motor.
- c) Sealed pre-lubricated ball bearings are acceptable only for small motors (Frame size 180 or less).  
Ball and roller bearing housings shall be such that re-lubrication, if required, can be carried out without stopping the motor. The minimum lubrication intervals shall be 4,000 hours for horizontal motors and 2,000 hours for vertical motors.

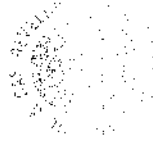

	<p style="text-align: center;"><b>SINJHATI PLANT PRODUCE WATER DISPOSAL</b></p>	 <p style="text-align: right; font-size: 2em; font-weight: bold;">54/1110</p>
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hours for vertical motors.

- d) To prevent damage to bearings by shaft circulating currents, the non driven end bearing shall be electrically insulated from the motor frame, if the induced voltage measured between shaft ends exceeds either 250 mV rms for ball and roller bearings, or 400 mV rms for sleeve bearings.

**TERMINAL BOXES**

- a) All terminal boxes shall be made of cast iron, cast steel, or 1/8 inch minimum thickness steel plate. Boxes shall be furnished with a threaded cable gland entry, watertight, and fully gasketed.
- b) The motor terminal box shall have IP55 or above weather protection.
- c) Terminal boxes for horizontal motors shall be on the right side when facing the drive-end from the top of motor enclosure. The terminal box shall be rotatable every 90 degree on any direction.
- d) Motor terminal boxes shall be clearly and permanently marked with reference letters in accordance with applicable standards.
- e) The terminal box and cable gland arrangement shall permit disconnection of the cable from the motor without disturbing the actual cable termination and seal.
- f) The main cable terminal box and auxiliary terminal boxes shall be separate.
- g) Conduit seal fittings with flexible conduits shall be used for cable entries in motor terminal boxes. For IEC based system, explosion proof cable glands shall be used.

	<p align="center"><b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b></p>	
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- h) Motor termination in terminal box shall allow star connection as well as delta connection.

### OPERATION

Motors shall be designed for re-acceleration, re-starting operation, if specified.

The plant motors will be designed with group re-starting after power recovery.

Manufacturer shall state their recommended residual voltage limit for re-starting, if any. There acceleration will be applied by time delay contactor against within 0.5sec voltage dip.

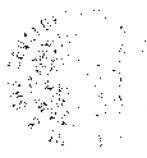

### 6.0 ACCESSORIES: SPACE HEATER

- a) Space heater shall be provided for motors, where required. The space heater shall be energized while motors are stopped.
- b) The space heaters leads shall be brought out into a separate terminal box from the motor main terminal box.
- c) The rated voltage of the space heaters shall be 230V, single phase, 50Hz.

### EARTHING TERMINALS

Each motor shall be provided with an external earthing terminal on the motor frame and an internal earthing terminal in the motor main terminal box. These earthing terminals shall be clearly and permanently marked with the letter "E".

### NAMEPLATES

	<p style="text-align: center;"><b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b></p>	
<p>Doc. No:4946-SP-004</p>	<p style="text-align: center;"><b>SPECIFICATION FOR ELECTRIC MOTORS</b></p>	<p style="text-align: right;">Revision No. 0</p>

The nameplate shall be provided in accordance with IEC / BS / NEMA, and additional non-corrosive metal plates shall be supplied to indicate the following:

- Motor Item Number.
- Direction of Rotation.
- Instruction for lubrication, with bearing numbers.

**7.0 FINISH**

- The exterior shall be thoroughly cleaned, scraped and wire brushed to remove all rust, grease and dirt immediately after preparation the exterior shall be primed with one coat of red oxide primer followed by two coats of best quality anti-corrosive finishing paint.
- The color of the finish shall comply with the specific job requirement.

**8.0 TEST AND INSPECTION**

- The motors shall be factory tested in fully assembled condition in accordance with the released IEC standards (or applicable standard) and manufacturer's QA/QC program.
  - Witness inspection, when so specified, shall be carried out in accordance with the requirements of "Scope of Inspection" in the requisition.
  - Tests on all motors shall be carried out in accordance with IEC unless otherwise specified and certified and test reports shall be furnished.
  - Tests for noise, vibration and over – speed shall be carried out and the vendor/supplier shall provide following curves for all motors:
-



	<p style="text-align: center;"><b>SINJHORO PLANT PRODUCE WATER DISPOSAL</b></p>	<p style="text-align: center;"><b>PE</b> Petrochemical Consultants</p> <p style="text-align: right; font-size: 2em;">57/142</p>
<p>Doc. No:4946-SP-004</p>	<p style="text-align: center;"><b>SPECIFICATION FOR ELECTRIC MOTORS</b></p>	<p style="text-align: right;">Revision No. 0</p>

- Time/ Current Curves
- Torque/ Speed Curves
- Terminal with stand Curves

#### 9.0 MANUFACTURER'S MOTOR DATA

- Contractor / Manufacturer shall complete and submit attached motor data sheet;
  - Contractor / Manufacturer shall recommend power factor capacity for improving the power factor to 0.98 lagging.
  - Manufacturer's drawing and data shall include not limited the following where applicable;
    - a. Complete dimensional outline drawing and general assembly drawing.
    - b. Terminal box assembly drawing
    - c. Recommended spare parts
    - d. Installation, operating and maintenance instructions
    - e. Connecting diagram with terminal marking
    - f. Complete dimensional outline drawing and general assembly drawing.
    - g. Terminal box assembly drawing
    - h. Recommended spare parts
    - i. Installation, operating and maintenance instructions
    - j. Connecting diagram with terminal marking
-



# OIL & GAS DEVELOPMENT COMPANY LIMITED

58/14/10

## SPECIFICATION # 4946-SP-001

## CORROSION INHIBITOR PACKAGE



CONSULTANTS:

Aug. 2018



### PETROCHEMICAL ENGINEERING CONSULTANTS

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	<b>CLIENT</b> <b>SINJHORO PLANT PRODUCED WATER DISPOSAL</b>		<b>CONSULTANT</b> 	
	<b>DOC. TITLE</b>	<b>CORROSION INHIBITOR SPECIFICATION</b>		
	<b>DOC. NO.</b>	<b>4946-SP-001</b>	<b>REV. 0</b>	

**GENERAL DESCRIPTION**

A skid mounted corrosion inhibitor injection package is required. The package shall be complete with Corrosion Inhibitor storage tank, injection pump, pressure relief devices, necessary piping and instrumentation required for continuous operation as per P&ID attached with this document. Injection pumps will take suction from feed tank and inject Corrosion Inhibitor into produced water injection flow line downstream of PD pump having discharge pressure more than 49 Bar. Mechanical power shall be taken off from the positive. Bidder to design the chemical injection package as per under mentioned displacement pump drive. Preferably chemical injection package shall be mounted on the same skid with preferable vendor Texstream USA or equivalent. Chemical storage Tank may be off skid type of 24hrs. capacity. Pump flow rate shall be designed for approx. 3500 BPD water production.

**NO OF PACKAGE REQUIRED**

TWO (2)

**REFERENCE**

P&ID for Corrosion Inhibitor Injection Package No. 4946-PID-002

**SCOPE OF SUPPLY**

The package shall take off the mechanical power from PD pump shaft through belt drive whereas corrosion inhibitor injection is required after Particle filters. The package shall comprise the following as minimum:

- Corrosion Inhibitor Injection Pumps (2 x 100%).
- Corrosion Inhibitor Storage Tank (one per skid)
- Pressure safety devices and instrumentation & control as per P&ID (as minimum)
- Bidder to design the chemical injection package as per under mentioned produced water system. Also compatibility of pump parameters must be i

**SPECIFIC REQUIREMENTS FOR THE PACKAGE**

- All instrumentation required for safe operation including protection of equipment.
- The package shall be designed for Zone 1, Group IIA & Temperature Class T6)
- All Interskid piping will be hydrotested as per ASME B 31.3
- At the battery limit of the package, Flanged 300# RTJ connection is required for corrosion inhibitor outlet.
- Vendor to review the instrumentation and controls and ensure the safe and continuous operation of the package, any other controls and safety devices required for the safe and continuous operation shall be under vendor.
- Bidder to select the the corrosion inhibitor pump compatible with the recommended corrosion inhibitors suppliers. Moreover, the pump turn down capacity shall be 10 to 100% of the injection rates with dilution or without dilution. Moreover, Water based corrosion inhibitor shall be preferable.

**PRODUCED WATER SYSTEM DETAIL**

Maximum flowing pressure	720
Liquid flow (BPD) (max/min)	3500/2000
Flowline Operating or Package Inlet Temp. Range (°F)	80-130
Produced Water Spec Chlorides ppm	46085
Density (kg/m <sup>3</sup> )	989
Liquid Viscosity (cp)	0.61
Operating pressure (Psig)	700

Produced Water Analysis	
Parameters	Value
Conductivity	>90,000 µs/cm
pH	5.8
Chloride (as Cl)	46085 ppm
Iron	78 ppm
Zinc	1.03 ppm
Free Chlorine	0.62 ppm
TDS	>60,000 ppm
TSS	64

1. The foundation size of Corrosion Injection Package Skid is 1.5 m \* 2.5 m. Vendor to provide the Package Skid as per given foundation size.

0	25/7/2018	Issued For Review	RK	RK	AJ
Rev.	Date	Description	Prepared	Checked	Approved





# OIL & GAS DEVELOPMENT COMPANY LIMITED

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## SPECIFICATION # 4946-SP-008

### SPECIFICATION FOR SKID MOUNTED PACKAGE



CONSULTANTS:

Aug. 2018





#### PETROCHEMICAL ENGINEERING CONSULTANTS

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	<b>SINJHORO PLANT PRODUCED WATER DISPOSAL</b>	
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**1.0 INTRODUCTION**

**1.1 GENERAL**

This specification covers the minimum requirements for the design, manufacture, supply, inspection and testing of skid mounted packages.

**1.2 DEFINITIONS**

Following definitions apply throughout this document:



Company / Owner	Oil & Gas Development Company Limited (OGDCL)
Contractor	"Contractor" means the person or persons, firm or Proprietor whose proposal has been accepted by the Company for verification of FEED package, engineering design, procurement, inspection, supply of material and equipment, construction/ commissioning, performance testing, one year of defect liability period and training of Company's personnel for the project and includes the Contractor's representative(s), successors and permitted assignees.

Vendor / Supplier	The organization, firm or agency with whom order for the supply of equipment and or material has been placed.
-------------------	---

**1.3 ERRORS OR OMISSIONS**

The review and comment by the COMPANY of any drawings, procedures or documents referred to in this Specification shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR / SUPPLIER of its obligations

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to comply with the requirements of the purchase order. Any errors or omissions noted by the CONTRACTOR / SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

**1.4 DEVIATIONS**

All deviations to Technical Requirements shall be made in writing and communicated to COMPANY at the bidding stage. Written approval of the COMPANY shall be obtained prior to executing the work.

**1.5 CONFLICTING REQUIREMENTS**



In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in the Project Specification or any other documents, the CONTRACTOR / SUPPLIER shall refer to the COMPANY whose decision shall prevail.

**1.6 REPORTING PROCEDURE**

A full reporting and recording system, to be agreed with the COMPANY, shall be implemented and maintained throughout the duration of the Contract. CONTRACTOR / SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY. Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

Further, the CONTRACTOR / SUPPLIER shall make testing records available for inspection at any time upon request.

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**1.7 THIRD PARTY INSPECTION**



In addition to the inspection and witnessing of tests by the inspectors to be appointed by the CONTRACTOR / SUPPLIER during the manufacturing and shipment of the Equipment Material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at manufacturer's facility under this specification.

**1.8 UNIT RESPONSIBILITY**

The CONTRACTOR / SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the skid mounted packages, including full compliance with all applicable design codes and standards, including those listed in Section 2.0 of this document, and the requirements of the certifying authority (if applicable).



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**2.0 CODES AND STANDARDS**

**2.1 Codes, Standards and Regulations**



The skid mounted packages covered by this specification shall be designed, manufactured and tested in accordance with the requirements of this specification, the attached data sheets, other referenced Project Specifications and the following Codes, Standards (latest edition) and Statutory Regulations (where applicable):

AISC Standard	American Institute of Steel Construction, Specification for the Design, Fabrication & Erection of Structural Steel for Buildings.
API 615	Sound Control of Mechanical Equipment for Refinery Services.
API Publication 700	Checklist for Plant Completion.
ASME VIII Div. 1	Pressure Vessels

**2.1.1 APPLICABLE PROJECT SPECIFICATIONS**

- Specification for Positive displacement Pumps
- Specification for Export Packing & Crating
- Specification for Painting and Surface Preparation
- Specification for Production Welding
- Specification for Unfired Pressure Vessel
- Specification for Motor
- Specification for Cable system Installation work

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### 3.0 SCOPE OF SUPPLY

The overall scope of supply for each Skid Mounted Package(s) shall be as indicated in the appropriate requisition. Each package shall be supplied as a self-contained unit mounted on a structural steel skid base, complete with the following as a minimum:


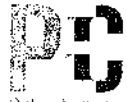
- All necessary interconnecting pipe work and valves, terminating at the one edge of the skid, complete with any heat tracing, insulation and supports.
- All necessary instrumentation and controls.
- All necessary electric cabling and cable trays.
- All necessary start-up and commissioning spares.
- All special tools required for maintenance of the package.
- All necessary noise suppression equipment.

All documentation as requested in this specification and its attachments. Inspection and testing as called for in this specification and its attachments.

The CONTRACTOR / SUPPLIER shall be responsible for the complete design, engineering, coordination, fabrication, construction, installation/erection, inspection, testing, delivery and proper functioning of the equipment, notwithstanding any omissions from this specification.

To enable the CONTRACTOR / SUPPLIER to offer performance and mechanical guarantees in accordance with the requirements of this specification and the appropriate section of the other referenced specifications, the CONTRACTOR / SUPPLIER, as a minimum, shall be responsible for:



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- Sizing of all equipment.
- Selection of materials of construction together with design temperatures and pressures.
- Layout of items of equipment within the specified skid dimensions.
- Procurement and testing of individual items of equipment.
- Assembly and testing of the skid mounted package.
- Full compliance with the requirements of any nominated certifying authority and the supply of all documentation as required to obtain final acceptance certification.
- Confirmation of the final weight, Centre of gravity position and dimensions of the skid mounted assembly and its suitability for transportation.

CONTRACTOR / SUPPLIER shall provide at the bidding stage, statement of complete compliance with COMPANY supplied approved Contractor / Vendor list. CONTRACTOR / SUPPLIER shall provide a detailed schedule and programmed of work for the design, procurement and manufacturing phases of the contract and shall mention explicitly the delivery period for the complete scope of supply.

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#### 4.0 DESIGN

##### 4.1 ITEM DEFINITION

A skid package is a self-contained, skid-mounted, operational piece of equipment with all interconnecting piping and wiring installed for connecting to utility and process systems. A skid package includes the following items:

- Major equipment
- Auxiliary equipment
- Control panels
- Pressure vessels
- Instrumentation and controls
- Electrical Equipment
- Structural skid base

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**5.0 CHARACTERISTICS**

**5.1 PERFORMANCE**

- a) A skid package shall be suitable for the operating conditions and design life specified in the Technical Requirements.
- b) A skid package shall have a minimum service life of 20 years in the specified environment.
- c) In addition to the design operating point of major equipment, CONTRACTOR / SUPPLIER shall also guarantee performance at the alternate or "off" operating conditions; i.e., additional cases, minimum turndown, or upsets.

**5.2 PROTECTION OF EQUIPMENT**

Protection of equipment during manufacture shall be in accordance with Technical Requirements.

**5.3 RELIABILITY**



Reliability shall be in accordance with Technical Requirements. The package / complete skid mounted equipment shall be designed for high reliability and minimum downtime.

**5.4 DESIGN AND CONSTRUCTION**

General

- a) The skid package shall be designed and constructed to ensure maximum compatibility with other process and/or utility equipment of the plant.

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- b) The skid package shall be designed to minimize installation, pre-commissioning, and start-up time.
- c) The skid package shall be laid out to provide for easy access to all equipment and appurtenances. Permanent maintenance and safe access must be provided to all equipment, instruments, electrical items, etc. on the skid.
- d) Changes in process conditions may occur during the life of the equipment. The possibility for changes shall be taken into consideration in determining operational flexibility, layout, and sizing of equipment.

**5.5 EQUIPMENT LAYOUT AND INSTALLATION**

- a) Major equipment such as drivers, driven machinery, pressure vessels, and heat exchangers shall include a base plate or another structural support system in accordance with Technical Requirements.
- b) Unless otherwise specified by the individual equipment specification, all equipment shall be attached to the main skid members with high-strength bolts as appropriate.
- c) The placement of all major and auxiliary equipment shall provide sufficient clearance for safe and easy operation and maintenance of the entire package.
- d) If the equipment is fully enclosed, hazard detection and protection equipment and a cooling/ventilating air supply shall be included within the enclosure.
- e) Equipment enclosures shall include access doors, removable sidewalls, or roof panels for operation/maintenance access.
- f) Coolers shall be located to avoid the intake of engine exhaust gases and recirculation of cooler discharge air.

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- g) No cabling piping or instrument tubing shall be routed within the skid base.
- h) All equipment shall be located within the package so as to afford easy access for maintenance and personnel safety. No part of the equipment shall overhang the boundaries of the skid.

**5.6 SKID BASE**



The complete package (including all major components, vessels, auxiliary equipment, and local controls) shall be mounted on a rigid structural-steel skid. Interconnecting piping and wiring shall be installed and ready for operation. Individual skids for packaged equipment shall not exceed the dimensions specified in the Technical Requirements without prior written approval of COMPANY.

If more than one skid is necessary to mount equipment packages, the skids shall be designed to be rigid when joined. The design shall be submitted to the COMPANY for approval. Where the skid is too large for handling or transportation on land, it may be subdivided into sections for re-joining and bolting together on site. In such cases, all equipment upon the skid, including interconnecting piping and cabling, shall be preassembled and match marked before disassembly to assist re-assembly on site.

Skids shall be designed in full accordance with sound structural engineering principles and the American Institute of Steel Construction (AISC) specifications, where applicable. Skids shall be of all welded construction. The skid shall be fabricated in accordance with the Technical Requirements.

When a single lift point from the skid base is impractical due to location of on-skid equipment, CONTRACTOR / SUPPLIER shall supply suitable spreader beams or lifting frame, complete with all slings and shackles. Spreader beams/lifting frames shall be of all welded construction using full penetration welds and shall be designed

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for the same load factor as skid lifting lugs. The primary beams (longitudinal base members) shall be considered to be simply supported with the support locations occurring at the extreme ends of the beams. The maximum allowable deflection of any primary beam shall be 1/500 of the span between supports under conditions of dead, plus superimposed, loads.

Cross members shall be designed on a similar basis and sized such that the top faces are in line and flush with the top faces of the primary beams, whilst the lower faces shall be such so as to give a minimum of 40mm ground clearance. The spacing of cross members shall not exceed the maximum allowable unbraced length of compression flange for the primary beams (defined in the AISC specification).

Slots shall be provided within the skid base members to allow retained liquids to drain away e.g. during wash-down. The primary members shall be adequately cross-braced to prevent flexing or distortion of the skid during transportation and installation. Equipment mounted on the skid shall not be considered as contributing to the structural strength or bracing of the skid.



The underside of skid frames shall be left flat to provide a continuous bearing surface and bolt holes or bearing pads shall only be provided where so indicated on the data sheet. Where alignment of machinery is critical CONTRACTOR / SUPPLIER shall propose a point-mounted skid, using bearing pads, as an alternative to his standard. The position of the support parts shall be agreed with the COMPANY. Where required all machinery shall have suitable anti-vibration mounts provided between the machine and the skid or between the skid and the deck.

Where required flexible bellows shall be fitted to prevent vibration transmission through ducting or piping. All other types of skids should be reviewed against the calculated or known deflection of the platform deck and the exciting forces.

Foundation bolts shall be supplied by CONTRACTOR / SUPPLIER. CONTRACTOR



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/ SUPPLIER shall provide full details of the size and number required. The skid base, associated steelwork and all equipment shall be designed for a basic wind speed of 50 m/s at 10 m above sea level. Wind pressure and stress analysis shall be computed in accordance with ANSI A58.1.


Skids shall have hot dipped galvanized steel bar floor grating covering the entire top surface with cutouts for supports and/or equipment. Floor grating shall not be used as a mounting surface for equipment or supports. Floor grating shall be fully located by side and end stops and suitably bolted or clipped. Grating to be in removable sections, each section and all cutouts to be completed with flat edging bars. Where grating sections are cutout around equipment and edging bars welded in to suit, complete section of flooring shall be re-galvanized to original specification. Cold galvanizing of re-worked areas is not acceptable.

Metal thicknesses at the point of equipment bolting shall not be less than 10mm. Pad-eye type lifting lugs shall be welded to the skid with full penetration welds. The pad-eyes shall be designed for a minimum load factor of 2.0, with no increase in AISC permissible stresses, on the calculated force and for all sling angles between 45 and 75 degrees to the horizontal, as obtained from a single point lift.

Jacking screws, of robust design and construction shall be provided on all skids supporting heavy machinery in order to facilitate lateral and axial movement of each equipment during alignment. Skid bases shall be provided with two earthing bosses suitable for termination of 70 sq. mm earth cable.

All items such as equipment, valves, controls, instruments, and piping forming a part of the skidded assembly shall be installed such that they are located entirely within the confines of the skid base. The projection of such items beyond the edge of the skid base is strictly prohibited, unless approved in writing by COMPANY. Valve hand wheels and equipment requiring frequent or regular maintenance shall be positioned on the skid for easy access. Additional details such as the deck-support structures

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and weight control requirements shall be furnished to COMPANY as required.

### 5.7 ANCILLARY STRUCTURES

All ancillary support structures shall be designed so as to withstand all superimposed loads, including wind loadings in accordance with the AISC specifications.

Access ways, handrails and ladders shall conform to the requirements of API RP 2A, and shall be provided for operating and maintenance access to all instruments, controls and valves when located more than 1.5m above the skid floor.

All piping and cabling shall be suitably supported for service and shipment. The support and installation shall be designed to allow for piping and cabling to be removed without the cutting of structural members.



Where filter type units with removable heads and/or internal elements form part of the package equipment, permanent handling facilities shall be provided on the package for removal of head/elements. This requirement applies when the weight of any single component exceeds 25kg or where easy access is not available.

### 5.8 VESSELS

All vessels shall comply with the Technical Requirements. Vessel internals shall be designed in accordance with the particular service of the vessel and shall be readily removable through a convenient manway. The internals shall be designed so that the performance of the vessel will meet the minimum requirements specified in the data sheet and shall be suitably fixed in position by the provision of bolts or clamps. Loose internal equipment is not permitted.

Any internals, which require periodic maintenance or are liable to heavy wear shall

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be designed for ease of removal from the unit and shall be provided with permanent access facilities.

All liquid outlet nozzles shall be fitted with vortex breakers unless otherwise stated in the data sheet.

**5.9 EXCHANGERS**

Thermal and mechanical design of exchangers and other equipments, including vibration analysis for shell and tube type shall be provided by the CONTRACTOR / SUPPLIER. Fouling factors used shall be specified on the data sheets.



**5.10 PIPING, VALVES & FITTINGS**

Piping shall provide proper flexibility and shall be easily accessible for operation, maintenance, and thorough cleaning. Piping systems shall be routed and supported so as to have sufficient flexibility to allow for thermal expansion and contraction, and for platform movement. CONTRACTOR / SUPPLIER shall demonstrate to the COMPANY that suitable flexibility analyses have been carried out.

CONTRACTOR / SUPPLIER shall minimize forces and movements imposed on Offskid pipework and shall provide a complete set of forces and moments at each Termination point in order that COMPANY may complete analysis of adjacent piping systems. Alternatively, piping which interfaces with off-skid piping shall be anchored such that it places no resultant forces or moments on the off-skid piping.

Piping within the package shall be installed, fabricated, inspected and tested in compliance with Technical Requirements. Piping and tubing shall be firmly mounted in a neat and orderly arrangement. Piping and tubing shall not obstruct access for operation, maintenance, or adjustment.

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Where appropriate all piping on the skid that is common, i.e. drains or vents should be piped together and terminate with a single flange at the skid edge. Interconnecting piping and fittings shall be prefabricated and mounted permanently within the package prior to testing and acceptance.

Interconnecting skids shall be joined by flanged piping and such piping shall be checked for proper fit-up by assembly in the CONTRACTOR / SUPPLIER'S shop. Package piping connections to plant Off-skid process and utility systems shall be grouped at a single location at the skid edge.



All piping shall be routed to provide a neat and economical layout, to have the shortest run consistent with Good Engineering Practice and to ensure easy access to all in-line valves and instrumentation. No piping shall be routed across walkways or access-ways unless they are elevated a minimum of 2.13m above the top of grating level.

Sufficient space shall be allowed between lines to permit ready access for removal/repair but in no instance shall there be a distance of less than 25mm between a pipe and the outside of the largest flange or fitting in the adjoining pipe. Insulation thicknesses and thermal movement of piping shall be taken into account when determining these spacing's. The minimum vertical clearance for all piping systems from top of flooring shall be 200mm.

Piping at all equipment shall be supported so that equipment, control valves etc can be readily removed without provision of temporary piping supports and arranged so as to minimize pipework dismantling. Pipe supports shall be provided adjacent to skid edge for all external piping connections. Plate type supports with rigid fixing through pipework flange bolting are not acceptable.

All access platforms and walkways shall have a minimum clear width of 800mm. No

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piping, instrumentation or cable runs shall impinge on this minimum requirement. Equipment and piping shall be installed with supports so as to prevent vibration.

All piping termination points, including inlets, outlets, utilities and drains shall terminate in ANSI B.16.5 flanges of the appropriate rating having a minimum size of 2 in unless otherwise approved by the COMPANY. The pipework shall be constructed to allow complete draining of equipment and shall have plugged vents at high points to facilitate venting and hydro testing.

All piping connections shall terminate at the edge of the skid. CONTRACTOR / SUPPLIER shall provide a suitable termination flange schedule with the general arrangement drawing(s). Final orientation of termination points shall be subject to COMPANY'S approval. Flanged Piping connections shall have minimum 02 threads exposed beyond nuts.

If standby components are provided, valves shall be installed as necessary to bypass and/or allow removal of the components for maintenance without the necessity of draining systems or shutting down the driver or driven equipment. Piping supports shall comply with the Technical Requirements. Piping supports shall allow piping to be removed without cutting the main structural members.



**5.11 MATERIALS OF CONSTRUCTION**

CONTRACTOR / SUPPLIER shall ensure that the design and selection of materials of construction for equipment are chosen to avoid the possibility of galvanic corrosion where necessary by the use of suitable insulation gaskets or spools.

**5.12 INSTRUMENTATION & CONTROL**

Unless otherwise specified, the package control and instrumentation systems shall

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provide sequential start-up, stable operation, warning of abnormal conditions, monitoring of operating conditions, and shutdown of the associated equipment in the event of impending damage to the equipment or operating personnel.

System shall be designed for failsafe operation. The package control system shall be pneumatic and/or electrical, as specified.

CONTRACTOR / SUPPLIER shall supply all piping, tubing, valves, and fittings for all instruments and instrument panels. All instrumentation and controls shall be furnished in accordance with the Technical Requirements as given in project scope of work and specifications.



Where instrument air is required on the package, air header shall be 1" NB minimum and shall be mounted adjacent to all instrument air users. Each user shall be connected to the main header using suitable tubing, fittings or adapter as required. The main header shall also have 2 Nos. spare connections with block valves. All take-offs shall be from the top of header.

All instrument cables shall be run in conduits on the skid. Sizing of conduit and routing shall be decided by the CONTRACTOR / SUPPLIER as per the skid layout requirements.

Conduits shall be installed with proper supports and all necessary accessories complete in all respects. All instrument cables shall be terminated properly using proper lugs.

Cables from all instruments shall be terminated in skid mounted Junction Boxes, (and terminal block in PLC cabinet). The junction box shall be suitable for respective hazardous area classification and shall have cable entries fitted with explosion proof seals, myer hubs, unions etc and standard earthing terminal sails.

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Where a Local Control Panel or Annunciation is provided the equipment shall be protected with a suitable weather hood. Control panels shall be locally mounted on the skid or remotely mounted in a nonhazardous control room as defined in the Technical Requirements.

Independent control panels shall be provided for each equipment package. Locally mounted electrical and pneumatic control panels shall be in accordance with the Technical Requirements. Control panels shall be suitable for an uncontrolled environment and the area classification specified.



Control panels and controls shall be completely piped, wired, and tested. The necessary alarms and shutdown devices for each piece of equipment in the package shall be installed on control panels. Alarms and shutdown devices shall include fail-safe circuitry.

Status indicators shall be provided to indicate running, service functions, and fault conditions with first out indication dependent on the equipment contained within the package.

All non in-line instruments shall be provided with suitable stands. Instruments may be supported on Package Steelwork where location and access is suitable. Instruments shall not be supported off Process Pipe work. CONTRACTOR / SUPPLIER shall supply Instrument location drawing separate from Package General Arrangement, highlighting true positions of all instruments in both Plan and Elevation.

Tubing shall be in accordance with the Technical Requirements and shall comprise of Swagelok or similar fittings. Mixing of fitting manufacturers is not allowed. Tubing connections from the package to the platform controls or control panels shall be completely piped to a bulkhead plate. The bulkhead plate shall be located at the skid edge. Tubing connections shall be terminated with bulkhead fittings.

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Bulkhead fittings shall have Female National Pipe Threads (FNPT). Tubing shall not block equipment requiring access for operation and maintenance, and shall permit easy removal of items for servicing. Flexible stainless steel braided hose shall be installed in applications requiring adjustment or flexibility such as belt tensioning, equipment alignment, or vibration isolation.

**5.13 ELECTRICAL**

Refer project scope of work, "Specifications for Electrical Design criteria" In general electrical wiring within the package shall comply with Technical Requirement. Unless otherwise specified, wiring shall be through unarmoured cable installed in G.I. conduit and/or copper-free aluminum cable trays. Mineral-insulated cable shall not be accepted unless specified by the Technical Requirement.

All cabling requiring to be connected to CONTRACTOR'S supplies/cabling, shall be provided with junction boxes adjacent to the skid edge and located to suit the COMPANY'S layout requirements. Junction boxes shall be positioned at the edge of the skid to facilitate connecting with external services and control systems. Where Local Control Panel or Annunciation is provided complete hook-up to Panel shall be carried out by CONTRACTOR / SUPPLIER.



Electrical cable shall be routed to minimize the likelihood of mechanical damage.

Electrical lines greater than 208 VAC, such as power leads and motor starters, shall have empty cable tray running to the skid edge in case these are to be connected to outside skid systems. Cable trays shall be of heavy duty type with deep flange to further protect cable runs. The cable will be installed and interconnected at the fabrication site by CONTRACTOR.

All electrical equipment provided on skid including and pump motors shall be provide



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with explosion proof terminal block suitable for Class I, Div. 1;

The power equipment voltage rating for all skid mounted electrical equipment shall be communicated to the COMPANY by the CONTRACTOR / SUPPLIER. Power supplies available to the package shall be as specified in the equipment requisition or attachments. If any voltages outside this supply are required these must be generated by the Package Equipment from these supplies.

Electrical equipment, which requires external support shall be provided with purpose built stands or may be supported from Package Steelwork where suitable. Electrical equipment shall not be supported off Process Pipework.

Where junction box/control panel cable glands are bottom entry (preferred arrangement) equipment shall be so located as to allow adequate space for routing and glanding off cables.



**5.14 BOLTING**

All internal bolts shall be provided with double locking nuts or other suitable securing device approved by the COMPANY. All external bolting shall be cadmium plated for protection.

**5.15 INSULATION**

Unless otherwise agreed the CONTRACTOR / SUPPLIER shall be responsible for the provision of all necessary insulation for heat conservation or the safety and protection of personnel in accordance with the applicable statutory requirements. This shall include the provision of suitable lagging and cladding on hot & cold surfaces within easy reach of operatives. The insulation shall comply with the Technical Requirements. In no circumstances shall insulation materials contain

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asbestos.

**5.16 LUBRICATION**

Each piece of equipment in the package shall be provided with the necessary lubrication system and fittings.

**5.17 NOISE**

The noise levels from each skid shall comply with the requirements of API 615 but shall not exceed 85 dBA at 1 m unless stated otherwise on the data sheets, or separately approved by the COMPANY.

**5.18 PAINTING & PROTECTIVE COATINGS**

Painting and application of protective coatings shall be done in accordance with project Specification for Painting & Surface Preparation



**5.19 IDENTIFICATION & MARKING**

Corrosion-resistant, 316L stainless steel nameplates or tags shall be securely attached to all identifiable pieces of equipment.

Rotating equipment shall have arrows indicating the direction of rotation. Rotation shall be cast into the equipment or stamped on 316L stainless steel plates and mounted with 316L stainless steel fasteners.

Major equipment such as pumps and compressors shall be supplied with a permanently attached, 316L stainless steel nameplate with the following information as a minimum:

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- Manufacturer
- Manufacturer's type
- Serial Number
- Item or tag number
- Size
- Maximum allowable design conditions – pressure, flow, temperature and speed
- Equipment weight in Kg
- Power rating or kilowatt (KW)
- Year of Production

Nameplates on engine drivers shall include the following information as a minimum.

- Manufacturer
- Manufacturer's type
- Serial number
- Rated speeds
- Trip speeds
- Ambient ratings
- Power rating (KW)
- Year of manufacturer
- Weight in kg

Instrumentation shall include securely attached stainless steel tags. Each tag shall

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include the identification shown on the process and instrumentation drawings as a minimum. Piping connections shall be tagged for identification as designated on the flowsheet diagram.

Bulkhead fittings shall have numbered identification tags to facilitate field hook-up. Nameplates and tags shall be attached to equipment with stainless steel screws or rivets. Adhesive shall not be acceptable. Tags may be attached to items with stainless steel wire only if screws or rivets are impractical.

Field connections shall be identified with a stamped or engraved stainless steel tag attached with stainless steel wire. The tag shall be painted red and shall identify connection points and applicable reference drawings. Instrument tubing shall be clearly identified at both ends and at junction points. Instrument and electrical cables shall be clearly identified at both ends and at junction points.

**5.20 SAFETY**

Safety precautions shall be in accordance with the internationally accepted standards with the following additional requirements:



The noise under normal operating conditions shall not exceed 85dB.

Sufficient instrumentation shall be provided for safe operation of the package. The instrumentation shall include an automatic shutdown system.

CONTRACTOR / SUPPLIER shall pay particular attention to ensure that all electrical equipment and installations are suitable for specified area classifications.

Metal guards shall be provided. The guards shall not be more than 13 mm (1/2 inch) away from stationary housings adjacent to all moving parts. This includes parts such

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as drive belts, cooler fans, and extension shafts. Wood or plastic shall not be acceptable guard materials.

Exposed surfaces subject to temperatures in excess of 60°C shall be insulated for personnel protection. The thermal insulation shall be suitable for extended service life in the specified environment and shall be in accordance with Technical Requirements.

Asbestos and asbestos products shall be specifically prohibited.

**5.21 CONTRACTOR / SUPPLIER REQUIREMENT**

CONTRACTOR / SUPPLIER requirements shall be in accordance with the Technical Requirement with the additional qualification that the CONTRACTOR / SUPPLIER shall assume full responsibility for engineering coordination of the major equipment, auxiliary equipment, piping, and other appurtenances within the package.



**5.22 DOCUMENTATION REQUIREMENTS**

Documentation shall be provided in accordance with the following requirements:

**GENERAL**

CONTRACTOR / SUPPLIER shall provide documentation that verifies:

- Equipment of similar size and configuration has been supplied within the past 5 years
- The equipment has been performing satisfactorily for at least one year.
- Equipment list, comprehensive startup, operating and maintenance

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documentation for all equipment shall be provided in hard copy and electronically to COMPANY. The number of required hard copies and electronic versions shall be determined within the Tender document.

A lubrication schedule shall be provided to ensure maximum equipment service life. The lubricating schedule shall detail the location, type, and frequency of service requirements for each system.

### Drawings



CONTRACTOR / SUPPLIER shall provide the COMPANY with drawings showing the number, type, and location (in plan and elevation) of all piping, electrical, and instrumentation connections and associated sizing and specifications. Skid connections shall be referenced on the drawings from one common reference point. CONTRACTOR / SUPPLIER shall provide piping drawings with bills of material and verify compliance with the piping and instrumentation diagrams and the piping and instrumentation specifications. All dimensions shall be in metric units. The drawings shall also include the following:

Arrangement, location, and method of fastening all equipment to skids or base plates;

Center of gravity for:

- Lift condition. This is comprised of the total weight of the skid package ready for shipment.
- Non-operating, dry in-place condition. This shall encompass the total weight of the skidded package when installed but not operating. No live loads are to be considered and all vessels and piping are to be empty.



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- Operating in-place condition. This shall encompass the total weight of the installed skid and all live loads that will occur during normal operation of the unit. The weight of fluids and solids in the process equipment and piping shall be included.
- Hydrostatic test in-place condition. This condition applies only to skidded units that will be hydrostatically tested. It does not apply to equipment that will be pressure tested with air. Weights to be considered shall be those for the non operating in-place condition plus the weight of water when all vessels and piping are filled.

CONTRACTOR / SUPPLIER shall determine the total weight of the package for each of the conditions indicated above. CONTRACTOR / SUPPLIER shall indicate the units of weight measured in metric. This data shall be included on the drawing showing the locations of the centers of gravity.

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**6.0 FABRICATION AND ASSEMBLY**

**6.1 GENERAL**

Approval of all CONTRACTOR / SUPPLIER'S drawings, weld procedures, calculations, etc. is required by the COMPANY and the certifying authority, where applicable, prior to the commencement of fabrication.

**5.1 WELDING**

All welding shall be in accordance with the requirements of the appropriate code i.e.:

Structural	ANSI / AWS-D 1.1 Project Specification for Structural Steel & the Welding and Inspection of Offshore Structures.
Piping	ANSI B31.3
Vessel / Exchanger	ASME VIII DIV 1, ASME IX

Welders shall be suitably qualified for the work undertaken.



**6.2 ASSEMBLY**

The CONTRACTOR / SUPPLIER shall be required to submit an assembly procedure for the skid mounted assembly detailing the order of erection.

**6.3 MATERIALS**

Materials of construction of the skid shall comply with the requirements of the Project



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Specification for Structural steel work ,where applicable.

## 7.0 QUALITY ASSURANCE PROVISIONS

Quality assurance provisions shall comply with the following requirements.

### 7.1 TESTS

#### 7.1.1 RESPONSIBILITY FOR TESTS & INSPECTIONS

The overall installation and testing program shall be incorporated in the master schedule. CONTRACTOR / SUPPLIER shall notify the COMPANY in writing at least 30 calendar days prior to the following events:

- Initiation of fabrication
- Completion of final assembly
- Final inspection
- Pressure tests
- Shipping of equipment
- Mechanical tests

CONTRACTOR / SUPPLIER shall be responsible for furnishing COMPANY with all specified certification on materials and with shop test data verifying that the specifications are being met.

CONTRACTOR / SUPPLIER shall maintain a record of shop test data for at least 18 months after the date of shipment. If specified, certified copies of test data shall be submitted to COMPANY prior to shipment.

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**7.1.2 TESTS & INSPECTIONS FOR COMPONENTS & SYSTEMS**



The mechanical operation of all equipment shall be satisfactory during the running test. Speed governors, alarm and trip functions, and over speed shutdown devices shall be tested to verify proper operation. Pressure parts shall not be painted until inspections are complete. Parts, material, and equipment purchased by CONTRACTOR / SUPPLIER shall be subject to the shop inspection.

Equipment installed on skid-mounted packages shall receive a mechanical running test prior to shipment as per details given in Technical Requirements. The proper mechanical operation of all auxiliary equipment, prime movers, and driven equipment shall be confirmed during testing.

Welding of piping and vessels shall be inspected in accordance with the Technical Requirements. Hydrostatic and mechanical testing procedures should be submitted to the approval by COMPANY.

Component quantities, description, and test data shall be checked for compliance with the Technical Requirements. Point-to-point electrical continuity tests shall be conducted. Equipment shall be checked for proper voltage, phase, and frequency.

Equipment shall be energized and equipment functional tests shall be conducted, including the running of all motors. The final operational tests shall cause relays and solenoids to function by simulation of control actions. This test shall demonstrate the functional integrity of all control circuits. In cases involving explosion proof equipment, seals shall not be poured until inspection is completed and approval to pour has been granted by COMPANY. Proper installation of grounding points shall be verified.

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### 7.1.3 SPECIAL TESTS & EXAMINATIONS

Piping on assembled skid units shall be pressure tested.

Tanks fabricated into the skid shall be pressurized with air to 0.05 barg and tested for leaks with a soap bubble test.

Drip pans shall be filled with water and checked for leaks and proper drainage.

Minimum standards for pressure testing shall be in accordance with the Technical Requirements.

#### Hydrostatic Tests



Hydrostatic tests shall be performed on vessels, piping, etc, as required by the Technical Requirements. All pressure vessels and piping shall be hydro tested in accordance with the appropriate project specification and code requirements. Process piping or tubing shall be tested with water after shop fabrication into subassemblies.

The normal test pressure for piping shall be 1.5 times the adjusted cold pressure rating of the valves, fitting, expansion joints or other limiting elements in the line. The normal test pressure for vessels, etc, shall be as per requirements governed by applicable codes or standards. Pressure testing shall be maintained long enough to permit complete inspection but shall not be less than 60 minutes.

#### Equipment Performance Tests

All equipment shall be subjected to an individual performance test where appropriate in accordance with the Standard Technical Requirements. Performance test curves

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and certificates shall be provided.

When required by the COMPANY'S Inspector, all equipment, after performance testing shall be dismantled for a visual inspection of the internals.

**Assembled Skid Testing**

Piping on assembled skid units shall be pressure tested as per requirements given in ASME B31.3. Hydrostatic tests shall be witnessed by the COMPANY. Minimum standards for pressure testing shall be in accordance with the Technical Requirements.



The completed pipe work assembled on the package shall be subject to leak test to a pressure as proposed by the CONTRACTOR / SUPPLIER and approved by the COMPANY in the CONTRACTOR / SUPPLIER's works to verify integrity of all joints. Drip pans shall be filled with water and checked for leaks and proper drainage. The completed assembly shall be given a full functional test including instrumentation and electrical equipment at the CONTRACTOR / SUPPLIER's works. During the test all alarms, shutdown and remote signals shall be simulated.

The CONTRACTOR / SUPPLIER shall be required to submit a full testing procedure, including a check list in accordance with API 700, at least 6 weeks prior to the commencement of testing and covering the full extent of testing on the completed assembly. The testing procedure shall be approved by the COMPANY prior to the commencement of testing and shall be complete with all equipment procedures and check lists. The CONTRACTOR / SUPPLIER shall be responsible for providing all necessary utility services to conduct the tests.

**Functional Tests**

The CONTRACTOR / SUPPLIER shall be responsible for ensuring all calibration and test equipment has valid certification. All instrument functions shall be verified by

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using water or instrument quality air as a substitute for the process liquid/gas to prove the integrity of the control equipment/instrumentation.

**7.1.4 CLEANLINESS INSPECTIONS**

COMPANY reserves the right to a final inspection for cleanliness of all equipment components and all piping and appurtenances furnished by or through CONTRACTOR / SUPPLIER prior to final assembly of any of the components. CONTRACTOR / SUPPLIER shall provide 5 days prior written notice to COMPANY that the equipment is clean and ready for inspection.

Special care shall be taken to wash fingerprints from highly polished machine surfaces prior to the application of rust preventatives. Equipment shall be promptly closed after acceptance of the equipment.

Pressure lubrication systems shall meet the cleanliness requirements of API 614.

**8.0 QUALITY CONFORMANCE INSPECTIONS BY CONTRACTOR / SUPPLIER**



**8.1 STRUCTURAL**

All structural members shall be designed to comply with the Technical Requirements.

Welds shall be examined by magnetic particle or other approved inspection methods in accordance with the Technical Requirements.

Pad eyes shall be designed in accordance with Technical Requirements and with the International standards and codes.

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### 8.1.1 FINAL INSPECTION & TEST

#### GENERAL

The package shall be complete in all respects before inspections and tests. The functional operation of the complete package shall be tested.



#### FINAL INSPECTION

Unless otherwise advised by COMPANY in writing, final inspections and hydrostatic testing shall not be performed unless COMPANY Representatives are present, or has waived right to inspection in writing. Such inspections and testing made in the COMPANY'S absence without COMPANY waiver shall be repeated in the COMPANY'S presence at the CONTRACTOR / SUPPLIER's expense.

The dimensions of all components including interconnecting piping shall be checked for compliance with the Technical Requirement. COMPANY shall be notified if a component is not found to be within the tolerances allowed by the Technical Requirement.

The adequacy of piping and equipment supports, lifting lugs, slings, and clamps, including size and location, shall be verified. Painting inspection shall be comprised of the following:

- CONTRACTOR / SUPPLIER shall verify that painting complies with the Technical Requirement.
- CONTRACTOR / SUPPLIER shall check general appearance.
- CONTRACTOR / SUPPLIER shall verify that paint has been removed from all control valve stems, instrument glass, nameplates, flange faces, and other machined surfaces, and other items that are not specified to be painted.

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Miscellaneous checks shall comprise the following:

- CONTRACTOR / SUPPLIER shall check adequacy of the compartment or skid drains.
- CONTRACTOR / SUPPLIER shall check general appearance, workmanship, and operability for things such as correct height of push button stations.
- CONTRACTOR / SUPPLIER shall check for safety hazards such as conduit installed over walking surfaces (tripping), and burrs on surface of handrails.

## 8.2 MATERIAL TESTING & CERTIFICATION REQUIREMENTS

Material requirements shall be as detailed in the Technical Requirement.

Inspection procedures and acceptance criteria shall be in accordance with the requirements of the applicable design code and the certifying authority (where applicable).



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## 9.0 PERFORMANCE GUARANTEES

The CONTRACTOR / SUPPLIER shall be required to guarantee that the completed assembly will meet the minimum performance requirements as stated in the data sheets, when operating under the stated design conditions.

The CONTRACTOR / SUPPLIER may, at the option of the COMPANY, be required to be present at, or to perform, site tests on the assembly in order to prove its performance.



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**10.0 PAINTING AND PREPARATION FOR SHIPMENT**

**10.1 PAINTING & PROTECTIVE COATING**

Painting and protective coating and the procedures for preparation for painting shall be in accordance with the Technical Requirements.

**10.2 PREPARATION FOR SHIPMENT**

Preparation for shipping and storage shall be in accordance with the Technical Requirements, with the following additional requirements.



**10.2.1 GENERAL**

Each skidded component shall be either securely anchored to the skid or removed to prevent damage during shipment. All instruments and any equipment removed from the skid for shipment shall be tagged and crated in waterproof boxes constructed from 51 mm (2-inch) lumber. Instruments shall be packed with sufficient desiccant for protection in transit and during storage at the job site. Boxes shall be securely attached to the skid for shipment. The contents of each box shall be clearly stated on the outside of that box.

Any equipment extending beyond the skid edge together with any other equipment or component parts removed for shipment purposes shall be tagged and crated in waterproof boxes constructed from 51mm (2-inch) lumber.

Exposed machined and threaded surfaces shall be coated with an easily removable rust preventative.

All flanged openings shall be protected with steel plate covers attached by proper

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bolting and sealed with a plastic compound.

Openings, threaded connections, wires, valve stems, and other component parts subject to mechanical damage or corrosion shall be adequately protected. Such protection shall consist of, but not be limited to, bolted metal flange covers, sealing with waterproof tape, enclosing with temporary metal housings, and coating all machined and threaded surfaces with a rust preventative. This protection shall be applied to all components, those removed and boxed and those remaining in place on the skid assembly.

Piping and handrails removed for shipment shall be properly tagged and secured to the skid from which it was removed.

Doors and windows in modules shall be protected from damage by covering with 19 mm (3/4-inch) plywood.

Overhead cranes shall be secured with a temporary locking device and bolted shipping blocks to prevent movement during shipment.



#### 10.2.2 INVENTORIES & APPROVAL

Inventories as indicated below shall be made by CONTRACTOR / SUPPLIER and submitted to COMPANY prior to shipment. Such inventories shall account for all items deliverable according to the governing equipment specification. An inventory of all major or tagged items installed on the skid for shipment an inventory of all items removed and secured to the skid for shipment a complete inventory of all boxes and the detailed inventory of the contents of each box. Each crate, bag or package shall be clearly identified with the purchase order number and identification symbol and shall be securely fastened to the skid.

The skid shall not be shipped before compliance with the Technical Requirements

has been verified, and released by COMPANY. If components are dismantled during

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	<b>DETAILED ENGINEERING DESIGN OF CONDENSATE LOADING SYSTEM AT NASHPA FIELD</b>	 PCC Consultants
Doc. No. : 2710-SP-006	Specification For Skid Mounted Package	Revision No. 0

preparation for shipment, instructions for their reassembly shall be included.



# OIL & GAS DEVELOPMENT COMPANY LIMITED

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## SPECIFICATION # 4946-SP-006

### SPECIFICATION FOR EXPORT PACKING AND CRATING

CONSULTANTS:



Aug. 2018



### PETROCHEMICAL ENGINEERING CONSULTANTS



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**1.0 INTRODUCTION**

This standard specification defines the minimum requirements for packing of equipment items in preparation for shipment to the Project Site.

**2.0 DEFINITIONS**

Following definitions apply throughout this document:

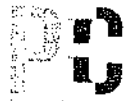
Company / Owner	Oil & Gas Development Company Limited (OGDCL)
Contractor	“Contractor” means the person or persons, firm or Proprietor whose proposal has been accepted by the Company for verification of FEED package, engineering design, procurement, inspection, supply of material and equipment, construction/ commissioning, performance testing, one year of defect liability period and training of Company's personnel for the project and includes the Contractor's representative(s), successors and permitted assignees.
Vendor / Supplier	The organization, firm or agency with who order for the supply of equipment and or material has been placed.

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**3.0 PRIORITY ORDER**

Priority order of documents controlling the Work performed shall be as follows:

- Local laws and regulations.
- Project specific engineering specifications as included in scope of work..
- Industry Codes and Standards (API, ASME, etc.).
- CONTRACTOR / SUPPLIER's bid response documents.
- In the event of any conflict between this specification and the requirements of other COMPANY specifications or industry standards and codes, the more stringent requirements shall apply with the written approval of COMPANY.

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**4.0 GENERAL REQUIREMENTS**

- Transportation shall also address packing requirements for single components, partial fabrications and completed items and be suitable for transportation whether by rail, road, plane or ship.
- Where applicable instruments shall be suitably tagged, packaged and crated.
- Package should be enclosed in cellophane and sealed against ingress of air.
- Title and address of the consignee should be printed /marked on at least three side of the crate.
- CONTRACTOR / SUPPLIER shall be responsible to provide the commissioning spares parts in separate crate.
- All Work shall be subject to inspection at any time. The CONTRACTOR / SUPPLIER shall immediately make any items available for inspection at the request of the COMPANY. The inspection or lack of inspection of the work by the COMPANY does not relieve the CONTRACTOR / SUPPLIER from the responsibility of performing the Work in accordance with this specification and shall make any repairs at his cost.
- Work shall not be released for shipment from CONTRACTOR / SUPPLIER's company ship until it has been inspected and approved by the COMPANY or such inspection and approval has been waived in writing from the COMPANY.
- CONTRACTOR / SUPPLIER shall be responsible for load out, packaging, bracing and securing for transportation for the work. CONTRACTOR / SUPPLIER shall provide COMPANY design, specifications, procedures and/or drawings on CONTRACTOR / SUPPLIER's plan for load out method,



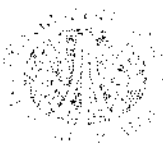

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transportation securing and bracing, packaging and field installation for COMPANY's approval 30 days before load out.

- Where applicable equipment is concerned the following shall apply:
  - a) All lifting devices necessary to lift and transport equipment and/or materials shall be fully identified, listed with the specific lift points and for large package items detailed prior to any handling operations. Spreader bar design calculation should be submitted to the COMPANY for review. Sling & shackles with adequate capacity and spreader bar should be provided along with shipped items by the CONTRACTOR / SUPPLIER.
  - b) All equipment should be empty and dry from test fluid.
  - c) All items subject to mechanical damage or corrosion shall be properly packed and protected from damage during shipment.
  - d) Exposed machined and threaded surfaces shall be coated with easily removable rust preventive.
  - e) Blank off all the nozzles with plastic caps.
  - f) Rounded shell should be supported with on wooden saddles with adequate numbers.
  - g) Exchangers shipped over the ocean shall be purged with nitrogen (N2) prior to closing for shipment and provided make-up with a N2 bottle. Exchanger shipped over land shall have a suitable desiccant, such as silica gel placed inside the nozzle.



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### CONTAINER STUFFING

- Weight should be evenly distributed throughout the container.
- Packages must not be placed on the top of other packages without adequate sub-flooring and bracing.
- All packages must be blocked and braced to prevent lateral, horizontal and vertical movement of the packages.
- All bulk heading, blocking, bracing and tie-down must conform to applicable railroad specifications for material shipped.
- All containers must be sealed with rail type seal numbers recorded for future reference.
- Locks are to be provided upon COMPANY's request.



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## 5.0 COMMERCIAL EXPORT PACKING SPECIFICATIONS

- This specification covers the minimum requirements for CONTRACTOR / SUPPLIER with regard to preparing equipment, materials and spare parts for shipment in wooden boxes overseas.
- Equipment and materials will be protected to withstand extended periods of storage at the jobsite.
- System specified herein contains the minimum requirements. If the CONTRACTOR / SUPPLIER's standard procedures for export packing will provide equal or better protection than specified herein, this information should be brought to the attention of the COMPANY for review and authorization.
- These requirements are minimum and are designed to protect the equipment and materials from the normal hazards associated with inland transportation, port handling, ocean shipping and worksite storage. If certain aspects of aforementioned activities are not addressed explicitly in this Specification then generally accepted handling and shipping practices shall be used by CONTRACTOR / SUPPLIER. CONTRACTOR / SUPPLIER is required to obtain written approval from COMPANY prior to apply any such practice or procedure.



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**6.0 EXPORT PREPARATION**

- All COMPANY's cargo shall be stored in a designated area and not intermingled with other cargoes to the extent possible.
- All wooden boxes, crates and skids shall be suitable for 4-way mechanical handling by forklifts or cranes. All heavy cardboard boxes should be banded to a pallet. All hood boxes shall clearly indicate the "Center of Gravity" and, where applicable, be marked "For Crane Lift Only" in English.
- CONTRACTOR / SUPPLIER shall ensure that every equipment or part of equipment is delivered to COMPANY according to the correct specifications.

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**7.0 EXPORT PACKING METHODS**

**7.1 METHODS**

It is important that all material arrive at its destination in undamaged condition. The intent of this Specification is to serve as a minimum requirement for "commercial packaging for export", but compliance does not relieve CONTRACTOR / SUPPLIER from responsibility for adequately packing materials, supplies and equipment.

The following methods apply to designated materials and materials not suited for container shipments. The choice of methods to be used will be selected by mutual agreement between CONTRACTOR / SUPPLIER and the COMPANY.



**Method I**

Preservative coating with greaseproof wrap. Method I requires the use and application of preservative compounds. The coated part or item shall be enclosed in a greaseproof bag or wrap of greaseproof barrier material that shall be loosely applied around the coated part of item and shall be secured by taping, tying or other suitable means. Projections, sharp edges or other features of the part or item, which may damage the barrier shall be cushioned. The type of barrier material and cushioning used shall be commensurate with the size, weight and irregularities of the preserved part or item.

**Method II**

Waterproof – Vapor Proof Barrier with Shell VPI-260. Items preserved, wrapped and cushioned shall be enclosed in a sealed bag. Shell VPI-260 (or equivalent when approved in writing by COMPANY) shall be in small porous bags positioned in the package at location such that the metal surfaces to be protected are within 300mm of the bags. Bags shall be secured by tying, by storage in especially provided baskets, by taping or otherwise secured so as to prevent movement, rupture of the bags or



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barrier and damage of the parts. Shell VPI-260 shall be in porous bags of standard sizes. Cushioning shall eliminate projections, sharp edges or other features of the item(s) that may damage the water-vapor proof barrier. A sufficient vacuum shall be drawn to cause the flexible bag to cling snugly to the enclosed item. Care shall be exercised to ensure that an excessive amount of vacuum is not drawn which might cause puncture or rupture to the flexible barrier or the equipment itself.

**Method III**



Packaging for Mechanical and Physical Protection Method III is intended only for items not susceptible to damage or deterioration from corrosion. Un-preserved items shall be bundled; secured by tying, taping or strapping, skin packaged or enclosed with wrapping, bags, cartons, boxes or other containers, as applicable to the extent necessary to provide protection from hazards of contamination and physical damage encountered in handling, storage and issue. When bags, wrap or other flexible barriers are used, cushioning shall be applied as required to protect the enclosing media. Items packaged in rigid containers shall be supported as necessary to prevent free movement. The methods of preservation - packaging, cushioning, blocking, bracing or bolting shall be applied to provide controlled movement within rigid containers to prevent rupture of flexible barriers and physical damage of contents due to transmission shock and vibration. Items such as machines and assemblies having bolt holes in parts of the item which are sturdy enough to resist breakage when roughly handled shall be bolted to one face of the container or to a base which can be secured by use of lock nuts or cotter pins, or by upsetting bolt threads by pricking bolt threads in four places.

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**8.0 PACKING MATERIAL/PRACTICES**

- For wooden boxes lumber shall be sound and well-seasoned, knots are permitted provided they are sound and tight and do not exceed one-third of the board width.
- For heavy cardboard, double wall, and waxed boxes, 227 kg (500 lb) test boxes are to be used.
- Plywood shall be construction and industrial grade and fabricated with exterior glue. It shall give equal strength in both directions of length and width and shall withstand full weather and water exposure.
- Nails shall be cement-coated.
- Metal strapping shall be un-annealed steel and applied to all packages with a stretching tool and secured with crimped steel seals. For heavy cardboard boxes nylon strapping securing the box to a pallet shall be crimped with steel seals.
- In all wooden boxes constructed with lumber or plywood the top shall be lined with waterproof paper where necessary.
- When consolidating material in a box or crate, items shall be packaged or nested reducing volume as much as possible. All items shall be braced and/or cushioned as necessary within the container to prevent damage from shifting.
- Small items and spare parts not secured to main item shall be separately boxed and properly identified as to its main item number.



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- All controls and instruments mounted on equipment, including motor starters, shall be protected internally with Ludlow VPI wrap, Daubert VCI paper or porous bags of VPI-260. Exterior doors will be sealed by applying petroleum jelly to the sealing surfaces and closing. The jelly will cause more efficient seal. CONTRACTOR / SUPPLIER may substitute equivalent materials for Ludlow VPI wrap, Daubert VCI paper, or porous bags of Shell VPI-260, if approved in writing by COMPANY.
  
- It is necessary that all shipping containers be tightly packed. Where voids appear, they will be filled with cushioning material or securely blocked off to prevent any movement of contents.
  
- Machinery and large equipment shall be skidded, and shall be bolted and strapped to the skids. As required, items shall be cradled within crates for stability purposes. Specific packing instruction, as mutually agreed between COMPANY and CONTRACTOR / SUPPLIER, will be included in the purchase order for crating or boxing of large equipment, if required.
  
- Heavy items shall be securely blocked and braced to prevent damage to lighter materials packed in the same box. Heavy items, where possible, shall be packed on the bottom with light items on the top.
  
- Outer packages shall be packed in such a manner to insure an even distribution of weight within the case. All other packages will bear warning signs on the outside denoting the center of balance and sling marks. Top heavy containers will be so marked as "top heavy" or "heavy end". Outer packaging shall be constructed in a manner that will provide protection from pilferage.



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## 9.0 TYPES OF PACKING

### 9.1 PALLETIZING

Items which are not crated or boxed and are impervious to damage from moisture, seawater, handling and external damage, which can be conveniently secured to a pallet to facilitate handling, shall be palletized.

### 9.2 BUNDLING & SKIDDING

All items shall be segregated to length and size and bundled or skidded into units not to exceed 1814 kg (4000 lbs) or 12 m (40 feet) in length unless previously approved by purchaser. Apply steel strap with a stretching tool and secure with crimped steel seals spaced up to 1-meter apart (40").



### 9.3 BOXES AND CRATES

The construction and reinforcing of a wooden box depends upon the weight of the box and its contents. The following are minimum requirements for various boxes.

45 – 1814 kg (100 - 4000 lbs.)

Box shall be made of a minimum of 25.4 mm (1-inch) nominal lumber board, 9.5 mm (3/8") plywood sheathing, completely cleated ends. All boxes over 22 kg shall be skidded. All seams shall be backed with an upright or brace.

1814 kg (4000 lbs) and up Box shall be constructed with a 102 mm (4") by 102 mm (4") nominal skid base. 51 mm (2") nominal floor, 25.4 mm lumber or 13 mm (1/2") plywood sheathing, with cleated ends. Top and sides shall be braced, with corner post, bracing and stiffening members of 51 mm (2") by 102 mm (4") nominal lumber. Load bearing members shall be placed as needed. Top and upper edge members of large or heavy boxes shall be reinforced with 102 mm (4") by 102 mm (4") or 102 mm (4") by 152 mm (6") nominal spreaders to prevent crushing of boxes when lifting-

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slings are used.

All wooden boxes to be fork liftable - 4 ways. Cardboard boxes to be of double wall waxed construction, 227 kg (500 lb) test and 1118 mm (44") x 1118 mm (44") x 1118 mm (44") OD with pallet. Intended to double stack and fit side by side in a standard 6.1 (20') or 12.2 m (40') shipping container

#### 9.4 STRAPPING

All wooden boxes must be strapped with a minimum of 2 steel bands running parallel to skids. 19mm (3/4") nominal banding may be used on boxes less than 180 kg. For boxes or crates over 2722 kg (6000 lbs) 32 mm (1 1/4") or 51 mm (2") nominal banding must be used.



#### 9.5 SPECIAL REQUIREMENTS

Electrical switchgear, electrical panels, chromatographs, computers, all material/ equipment which are susceptible to damage or deterioration from moisture, (i.e., humidity or rain), must be warehouse stored upon receipt and vacuum packed immediately, after checking. If the material has a discrepancy, all efforts should be made to quickly clear the discrepancy and pack the material.

**Note:** The above listed materials are not all inclusive and other possible applications should be noted and brought to the attention of COMPANY.



Special Materials: Any material which might need packaging differently than that which is stated herein shall be reviewed in writing on an individual item/order basis with COMPANY.

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**10.0 MARKING AND DOCUMENTATION**

- All material must be packed within 4 working days after receipt, if automatic pack Purchase Orders, or within 2 working days after release by COMPANY if inspection is required.
- Specific instructions for shipping markings and documentation procedures will be in the order. Color coding of all packages and/or pieces will be required. All packing/documentation shall be segregated according to COMPANY's Job No.
- All markings and tags on wooden boxed equipment, packages, and crates shall be paint-stenciled (not marking pens) and capable of remaining legible after extended periods of storage in bright sunlight and atmospheric conditions encountered enroute to storage at the destination.
- All markings and tags on heavy cardboard boxes may be written on "peel and stick" labels with indelible marking pens, provided writing is neat and legible.
- Combined Commercial Invoice/Packing Lists must be issued for each shipment indicating all material orders export packed per package, with copy attached to package detailing contents of that package prior to delivery to dock. If pricing is in question, Packing List only may be attached to package prior to dock delivery.
- Final Combined Commercial Invoice/Packing List covering all shipments for a particular vessel must be completed and delivered to COMPANY within 48 hours of last dock delivery. Transfer should take place electronically.

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## 11.0 REPORTING

CONTRACTOR / SUPPLIER will provide COMPANY with the following reports within the time intervals and at the frequencies shown:

- Cargo "On Hold" Report (Detailing all cargo "On Hold" pending resolution of problems). Nature of problem to be outlined on Report (e.g., missing Purchase Order No., overages, shortages, damaged materials, incorrect part numbers, etc.) Report shall be issued every Monday morning and transmitted to COMPANY electronically.
  
- "Packed Out" Report (Detailing all tonnage packed and ready for shipment). Report shall include CONTRACTOR / SUPPLIER's estimate of 12.2 m (40 ft.) Standard Containers needed to move cargo. Report to be issued weekly and transmitted to COMPANY.



# OIL & GAS DEVELOPMENT COMPANY LIMITED

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## SPECIFICATION # 4946-SP-002

### PAINTING AND SURFACE PREPARATION



CONSULTANTS:

Aug. 2018





#### PETROCHEMICAL ENGINEERING CONSULTANTS

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**1.0 PAINT WORK**

**1.1 GENERAL**

1.1.1. This specification defines the requirements for surface preparation, selection and application of paints on external surfaces of equipment, piping, etc.

When a particular part of work is being carried out, the painting system should be chosen in accordance with the environment in which the material to be painted will be located. Indeed, the degree of aggressiveness of the atmosphere that will be encountered in the environment of the work can range from an environment, which is not very aggressive to an extremely aggressive environment, depending on whether the location is in a rural area, a non-industrial built-up area, ventilated workshops, in the vicinity of the sea, at chemical plants, in humid rooms or in the vicinity of sources of cold or heat.



**1.2 CODES & STANDARDS**

The following codes and standards shall be followed for the work covered by this contract.

- BS 4232 : Specification for Painting requirement, surface preparation
- SSPC –Pittsburg, U.S.A. : Good Painting Practice and Surface specification SP 1 to 10 Manual volume-1
- DIN Standard 55928 : Specification for paint requirement for field painting work
- BS 4593 sec.4 : Specification for Inspection of finished painting.

**1.3 CONDITIONS OF DELIVERY**

a) Packaging

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Every recipient will be fitted with a hermetically-sealed lid with an opening that is sufficiently large to allow the contents to be stirred; the outside and inside are protected against oxidation, and, like the lid, are marked with a strip of colour identical to the contents.

#### 1.4 COMPOSITION OF THE PAINT PRODUCTS USED

##### a) Quality

The composition and quality of the products may not differ from batch to batch. A batch is all of the products of a specified manufacture. If the analyses of products bring to light that the composition does not conform to the specifications of the paint manufacturer, the Employer / Owner's Engineer may refuse to use this batch of products. The paint products must comply with the following conditions:

- They must have the viscosity necessary for the described use and the established condition ; use of the brush – paint roller (spray gun for special cases and in the workshop)



##### b) Quality control - Sampling

While the works are in progress on the construction site, the Employer / Owner's Engineer may carry out sampling on the paint being used for the purpose of checking conformity. The paint products must be made available free of charge to the laboratory or the approved supervisory body in sufficient quantities so that all the tests can be carried out on the same batch.

If the analyses reveal a non-conformity in the composition of the products used (tolerance of +3 % of the dosage of every component), the Employer / Owner's Engineer may refuse application of the product under consideration, halt the work / and have the non-conforming product already applied removed.

Before proceeding with the work a product data sheet with its test certificates & batch certificate is to be submitted to Employer / Owner's Engineer's approval stating that products offered is conform to the required specification. The only Purpose of the analyses is to reveal any nonconformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analyses concerned are not acceptance tests of the products supplied and in no way



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affect the obligations of the Contractor specified in the contract towards the Employer / Owner's Engineer.

#### 1.5 IDENTIFICATION

Every recipient will bear the following information:

- Name of the manufacturer;
- Date and number of manufacturer;
- Name of the product type;
- Batch no. with Test certificate
- Net weight of the product or the contents of the recipient;
- Date of the expiry.

At the time of delivery, this packaging must bear labels in conformity with the legal stipulations in force.

After completion of a job a general clean up shall be carried out by the Contractor to remove all debris, materials or irregularities that his work has brought to the site so that it is left tidy.



The restoration work includes among other things:

- the removal of abrasives;
- the removal of the different protective coverings;
- the Contractor will make the required repairs to any damage after refitting the supports;
- the removal of paint and cleaning of the stains on the floor.

#### 1.6 SURFACE PREPARATION STANDARDS

Following standards shall be followed for surface preparations. :

- 1 Swedish Standard Institution- SIS-05 5900-1967
- 2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)
- 3 British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS- 4232.

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- 4 National Association of Corrosion Engineers, U.S.A. (NACE).
- a) The contractor shall arrange, at his own cost to keep a set of latest edition of above standards and codes at site.
- b) The paint manufacturer's instruction shall be followed as far as practicable 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 and thinning.
  - Application of paints and the recommended limit on time intervals between coats.
- c) Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Employer / Owner's Engineer, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

## 1.7 PREPARATION OF THE SURFACES

### 1.7.1 General Specifications



The cases that occur in practice on building sites, with regard to painted surfaces, can be broken down as follows:

- material of which the oxide content disappears by natural oxidation;
- material that has already been covered with a layer of paint in the workshop;
- material that is covered with old paint layers that show different degrees of weathering.

Good preparation of the surface is the best guarantee for good anti-corrosion protection.

Paintwork shall never begin until the surface to be treated is dry and is independent of the base coat and cleared of dirt, dust, rust, scale, grease, salt attack, cement powder, cement mud-scale, sand, oil, etc.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

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- cleaning (bright blast-cleaning);
- mechanical cleaning;
- manual de-rusting.



The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods, regardless of the form or the condition of such surfaces. The cleaning devices that might be damaged during the surface preparation shall be screened off by the Contractor.

#### 1.7.2 Sandblasting

The blasting grits or sand to be used for blasting operation shall be tested for chloride content or the Contractor / manufacturer shall issue the certificate showing there is no chloride content in the product.

Before beginning cleaning by blasting, the person carrying out the work will take the following measures:

- clear the steel surface of oil and/or grease;
- ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- check that no blasting grains can get into the pipes during this process. Any openings not sealed off must be screened off;
- where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again or if removal of above is not possible then these items shall be covered & protect so that application of paint on main unit doesn't spoil above said parts.
- screen off all non-metal structures such as rubber where there is a filter;
- with valves operators and other devices care should be taken to ensure that no metal filings or paint get into the apparatus;

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To prevent rust forming quickly as the result of humidity on the blasted surface, cleaning by blasting may only be carried out when the temperature of the steel surface is at least 3°C higher than the dew point of the ambient air.

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choice of the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted - e.g. INOX (stainless steel). The abrasive to be used must conform to the local law i.e. it may contain no carbon and less than 1% free silicon dioxide. The Sa 3 will always be requested and must at least reach Sa 2½ during the initial stage of the paintwork. For blasting followed by metallization, the surface preparation degree to be achieved is always Sa 3. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard SVENSK STANDARD ISO 8501-1-1988 SS 05.5900.



- Sa 3: surface blasted down to the bare metal; when the surface is inspected with a magnifying glass, scale, rust and foreign bodies must be completely removed and it should be possible to raise a metallic -shine on the treated surface, the surface roughness shall be at least 75 µ.
- Sa 2 1/2: blasted very carefully. Scale, rust and foreign bodies must be removed in such a way that anything left behind will only be visible as nuances (shading) or strips.

The blast-cleaning will be carried out by means of compressed air free of water and oil. After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

### 1.7.3 Mechanical cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or another is technically unfeasible, mechanical de-rusting can be used instead. With mechanical cleaning by means of chipping, rotating steel brushes and sanding discs, a degree of cleanliness St 3 should be reached.

- St.3 : removal of the old paint layers of which the adhesion leaves something to be desired and / or of which the paint layer no longer fulfils the requirements.

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If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the Employer / Owner's Engineer prior to the start of the works.

N. B :

St 3 : means removal of every old paint layer. Retouching means local polishing with St 3 or Sa 3 followed by application of the desired painting system.

After mechanical cleaning, the surface should be made dust-free with a cloth or a soft brush, washed with an organic solvent and thoroughly dried off with a dry cloth (e.g. with 1.1.1. Trichloroethane such as Solvethane, Chlorothene NU).

#### 1.7.4 Manual de-rusting

Manual de-rusting with the aid of scrapers, steel brushes; sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation there from must be requested from the Employer / Owner's Engineer.



With manual de-rusting, a surface preparation degree St 3 must be obtained. The length of the handles of the equipment used may not exceed 50 cm.

#### 1.7.5 Preparation of a surface covered with a layer of paint in the workshop.

This layer is in general applied by the manufacturer for example on valves, Regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D3359, method A. The adhesion should be at least 4A.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts, it in the state in which the coating is found and the guarantee remains in force.

The Contractor, who must provide for the protection on the construction site. Must therefore obtain the information regarding the treatment of the surface and the quality of the paint that was used and must, moreover, examine the adhesion of the layer on the construction site, the percentage of damage and weathering as well as the value of the preparation of the surface in the workshop together with the thickness thereof that must be supplemented if necessary.

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a) Galvanized surfaces

Galvanized surfaces, both old and new will be carefully roughened up. Every foreign body (concrete splatters, chalk marks, grease and oil stains, etc.) will be removed. Thereafter, rub the surfaces with abundant water and, if necessary, with cleaning products.

To this end, nylon brushes will be used for every kind of dirt as well as for removing zinc salt residue. Thereafter, the surfaces will be treated in accordance with system 21. Where the zinc layer is lacking, it will be de-rusted manually to a degree of cleanliness St 3, after which a Primer coat will be applied in accordance with system 22.

b) Metalized surfaces treated with an impregnation layer

- Degrease with the desired degreasing product.
- Clean under high pressure or with a product prescribed by the paint supplier.



If the paint layer adheres well and is applied on a clean base, the painting system described may be continued. If the percentage of damage and weathering does not exceed 5 % / m. retouching may be considered. These partial repairs will be carried out.

If on the other hand, the percentage of damage does exceed 5 %/m or if the layer applied in the workshop comes loose, the Contractor must draw the attention of the Employer / Owner's Engineer to this and carry out the complete application system.

1.7.6 Preparation of surfaces covered with earlier paint layers that show different degrees of weathering.

If the surfaces do not show deep weathering limited to the spread of rust by small pitted areas or non-penetrative rust in spots, it will very often be sufficient to clean the surfaces with abrasives or with an abrasive disc. Then to rub them down with steel wool, remove the dust and wash off. If thick rust appears, in spots scale rust and active rust canker, this should be removed with needle hammers or stripped away directly by blasting, removing the dust and washing off.

1.7.7 Preparation of concrete or cement plaster surfaces

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Remove unsound paint layers and loose components with scrapers, blades or rotating steel brushes. Thoroughly clean the entire surface with water containing ammonia. Thoroughly remove moss, algae and fungal growths. Where these growths have been removed, treat the area with a fungicide in accordance with the instructions for use.

Once the entire area is completely dry, brush off the dead residue of moss, algae and fungus with a hard brush. In the case of reinforcement steel that has been laid bare, remove as rust, dust and grease as possible and treat with a primer coat. When painting concrete surfaces, they must first be checked for cracks. Cracks larger than 0.3 mm Must be repaired with an appropriate system in accordance with the type and extent of the repairs (e.g. injection with epoxy mortar). Repair damage such as cracks and bursts to concrete parts with a two-component mortar or preferably with micro-mortars. Finally, check the alkalinity of the surface with the aid of litmus paper and neutralize it if necessary.

#### 1.7.8 Use of solvents



It is sometimes necessary to use solvents when the surfaces to be painted are streaked with grease or oil. In this case a suitable organic solvent should be applied. The operation should be carried out with the aid of clean brushes or rags and clean solvent.

All the legal specifications in connection with solvents etc. must be adhered to. The Employer / Owner's Engineer shall be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to rule out any Possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

#### 1.7.9 Condition of the metal after stripping

The Contractor must call in Employer / Owner's Engineer for checking the condition of the metal during stripping and inform Employer / Owner's Engineer immediately of any damage that he might have noticed.

- Deep corrosion of the plates – rivets – bolts
- Faulty welding

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- Fittings that appear to be dangerous because of their age.

#### 1.7.10 Removing coating from surface pipelines

The Contractor must have the equipment necessary for the removal of asphalt from the pipe without damaging the latter (scratching, impact, etc.). The Contractor undertakes to carry out the work in accordance with an approved procedure.

### 1.8 CARRYING OUT THE PAINTWORK

#### 1.8.1 Conditions for carrying out paintwork

Painting may not be carried out in unsuitable conditions.

All preparatory work and painting may only be carried out in dry weather and at a minimum temperature of 10°C, except for special cases requested by the Employer / Owner's Engineer.

Unless otherwise stipulated in the specifications of the paint supplier, application of the paint is forbidden if it is forecast that the temperature will fall to below 0°C before the paint is dry. The temperature of the surface to be painted must be at least 3°C higher than the dew point of the ambient air. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

The work must be stopped:



- If the temperature of the surface to be painted is higher than that described by the supplier:
- If it is raining, snow, mist or fog or when the relative humidity is higher than 80 %.

Coats that have not yet dried and have been exposed to frost, mist, snow or rain and might thereby be damaged must be removed after drying and the surfaces must be repainted at the expense of the Contractor.

Working in direct sunlight or in hot weather must be avoided.

The first coat of paint must be applied maximum 3, hours after the preparation of the surface if the relative humidity of the air is between 50 % and 80 %. This time span



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may be increased to 6 hours if the relative humidity is less than 50 % in all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2½ at the time of painting.

The coats of paint may only be applied on carefully cleaned surfaces that must be dry and free of grease and dust.

### 1.8.2 Special conditions

Painting may be carried out when the Contractor can be sure that the instructions of the paint supplier have been scrupulously followed with regard to the parameters in the following (non-exhaustive) list:

- Ambient temperature
- Surface temperature
- Relative humidity
- Dew point
- Drying times

The Contractor must in this respect be able to produce the instructions for the paint on the site.

In addition, the paintwork may only be carried out to a minimum ambient temperature of 5°C and / or to a maximum relative degree of humidity of 85 %. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

Hand mixing of the paint shall be permitted for up to 5 liters only, the large quantity shall mixed by mechanical agitators and shall be maintained continuously during paint work to avoid quick pigment separation.

### 1.8.3 Paint Materials

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Paint material should withstand lower up to -10°C. Primer and finish coats shall be of class-I quality and shall conform to the following:

- a) Primer (P-1)



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Type and Composition: Single pack. Modified phenolic alkyd medium pigmented with redoxide and zinc chromate.

Volume solids                    30 – 35%  
DFT                                    25 microns/coat (min)

- b) Covering capacity                    12-13 M2/Lit/coat  
Primer (P-2)

**High build chlorinated rubber zinc phosphate primer**

Type and Composition: Single pack, Chlorinated rubber medium plasticized with unsaponifiable plasticiser pigmented with zinc phosphate

Volume solids                    35- 40%  
DFT                                    50 MICRONS/COAT (MIN)  
Covering capacity                    7-8 M2/Lit/Coat

- c) Primer (P-3)

**High build zinc phosphate primer**

Type and Composition: Single Pack, Synthetic medium. pigmented with zinc phosphate.

Volume solids                    40-45%  
DFT                                    35-50 microns/coat  
Covering capacity                    10-12 M2/LIT/coat  
Heat resistance                    Upto 100 C (dry)

- d) Primer (P-4)

**Etch Primer/ Wash Primer**

Type and Composition: Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.

Volume solids                    7-8%  
DFT                                    8-10 microns/coat



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Covering capacity 7-8 M/lit/coat

e) Primer (P-5)

Epoxy Zinc Chromate Primer

Type and Composition: Two pack, Polyamide cured epoxy resin medium pigmented with zinc chromate.

Volume solids 40%(min)

DFT 35 microns/coat(min)

Covering capacity 11-12 M/lit/Coat

f) Primer (P-6)

Epoxy Zinc Phosphate Primer

Type and Composition: Two pack, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.

Volume solids 40%

DFT 35 microns/coat (min)

Covering capacity 11-12 M / lit/coat

g) Primer (P-7)

Epoxy high build M10 Paint (Intermediate Coat)

Type and composition: Two pack. Poly Polymide cured epoxy resin medium pigmented with micaceous iron oxide.

Volume solids 7- 8%



Volume Solids 50%

DFT 100 microns/coat (min)

Covering capacity 5.0 M/lit/coat

h) Primer (P-8)

Epoxy Red Oxide zinc phosphate primer

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Type and Composition: Two pack, Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.

Volume solids                      42%  
 DFT                                      30 microns/coat (min)  
 Covering capacity                  13-14 M/lit/coat

i) Primer (P-9)

Epoxy based tie coat (suitable for conventional alkyd based coating prior to application of acrylic polyurethane epoxy finishing coat)

Type and Composition: Two pack , Polyamide cured epoxy resin medium suitably pigmented.

Volume solids                      50-60%  
 DFT                                      50 microns/coat (min)  
 Covering capacity                  10-12 M/lit/coat

j) Finish Coats (F-1)

Synthetic Enamel

Type and Composition: Single pack, Alkyd medium pigmented with superior quality water & weather resistant pigments.



Volume solids                      30-40%  
 DFT                                      20-25 microns/coat  
 Covering capacity                  16-18 M/lit/coat

k) Finish coat (F-2)

Acrylic Polyurethane paint

Type and Composition: Two pack , Acrylic resin and isocyanate hardener suitably pigmented.

Volume solids                      40% (min)

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DFT 30-40 microns/coat

Covering capacity 10-12 M / lit / coat

l) Finish Coat (F-3)

Chlorinated Rubber Paint

Type and Composition: Single pack, Plasticized chlorinated rubber medium with chemical & weather resistant pigments.

Volume solids 30%

DFT 30 microns / coat (min)

Covering capacity 1 0.0 M / lit /coat

m) Finish Coat (F-4)

High build chlorinated rubber M10 paint.

Type and Composition: Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.

Volume solids 40-50%

DFT 65-75 microns/coat

Covering capacity 6.0-7.0 M / lit / coat

n) Finish coat (F-5)

Chemical Resistant Phenolic based Enamel

Type and Composition: Single pack phenolic medium suitably pigmented.

Volume solids 35-40%



DFT 25 microns/ coat

Covering capacity 15.0 M /lit/ coat

o) Finish Coat( F-6)

Epoxy High Building Coating

Type and Composition: Two pack. Polyamide cured epoxy resin medium suitably

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pigmented.

Volume solids                      60-65%  
 DFT                                      100 microns/coat (min)  
 Covering capacity                  6.0-6.5 M / lit / coat

p) **Finish Coat (F-7)**  
**High build Coal Tar Epoxy**

Type and Composition: Two pack, Polyamine cured epoxy resin blended with Coal Tar.

Volume solids                      65% (min)  
 DFT                                      100-125 microns/coat  
 Covering capacity                  6.0-6.5 m / lit / coat

q) **Finish Coat (F-8)**

Self priming epoxy high build coating (complete rust control coating)

Type and Composition: Two pack. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manually prepared surface and old coatings.



Volume solids                      65-80%  
 DFT                                      125-150 microns/coat  
 Covering capacity                  4-5 M / lit / coat

r) **Finish Coat (F-9)**

Inorganic Zinc Silicate coating

Type and Composition: Two pack , Self cured Ethyl silicate solvent based Inorganic Zinc coating.

Volume solids                      60% (min)  
 DFT                                      65-75 microns/coat

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Covering capacity                      8-9 M / lit / coat

s)    Finish coat (F-10) High build Black

Type and Composition: Single pack. Reinforced bituminous composition phenol based resin.

Volume solids                            55-60%

DFT    100 microns/coat (min)

Covering capacity                      5.50-6.0 M / lit / coat

t)    Finish Coat (F-11)

Heat Resistant Aluminum Paint Suitable up to 250°C.

Type and Composition: Dual container (paste & medium). Heat resistant spec varnish medium combined with aluminum flakes.

Volume solids                            20-25%

DFT    20 microns/coat (min)

Covering capacity                      10-12 M / lit/ coat

u)    Finish Coat ( F-12)

Heat Resistant Silicon Paint suitable up to 400° C.

Type and Composition: Single pack Silicone resin based with aluminum flakes.

Volume solids                            20-25%

DFT    20 microns/coat (min)



Covering capacity                      10-12 M/lit/coat

v)    Finish Coat (F-13)

Synthetic Rubber Based Aluminum Paint Suitable up to 150° C.

Type and Composition: Single Pack, Synthetic medium rubber medium combined with leafing Aluminum,

DFT    25 microns/coat

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Covering capacity                      9.5 M /lit/ coat

**Notes**



1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All 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.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,
4. All primers and finish coats should be cold cured and air-drying unless otherwise specified.
5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.
7. In case of F-6, F-9, F-11 & F-12 Finish Coats, No Primer is required.

The paints shall conform to the specifications given above and Class-I quality

**Painting material**

Type	Designation
1. Inorganic zinc, silicate	Ameron Dimetecote 11 or approved equivalent
Thinner	Ameron A65 or approved equivalent
2. High-build polyamide epoxy	Ameron A383HS or approved equivalent
Thinner	Ameron A65 or approved equivalent
3. Acrylic silicone	Ameron 1999 or approved equivalent
Thinner	Ameron 65 or approved equivalent



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4. Silicone aluminium	Ameron A878 or approved equivalent
Thinner	Ameron A65 or approved equivalent
5. Epoxy primer-1	Ameron 71Tc or approved equivalent
Thinner	Ameron A65 or approved equivalent
6. Epoxy finish aluminium	Ameron 72 or approved equivalent
Thinner	Ameron 9HF or approved equivalent

**Notes:**



- (a) Amercoat 65 or an approved equivalent thinner shall be used for cleaning stainless steel surfaces prior to printing.
- (b) Amercoat 12 or an approved equivalent thinner shall be used for cleaning tools and equipment used for painting in accordance with this specification.

**STORAGE**

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by Employer / Owner's Engineer 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 words ' PAINT STORAGE No NAKED LIGHT highly -inflammable shall be clearly displayed outside.

**COLOUR CODE FOR PIPING**

- i) For identification of pipelines, the colour code as per Table -1 shall be used.
- ii) The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it
- iii) Colours (Ground) as given in Table-2 shall be applied throughout the entire length of un-insulated pipes, on the metal cladding & on surfaces, ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied as per approved procedure.

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#### IDENTIFICATION SIGN

- i) Colours of arrows shall be black or white and in contrast to the colour on which they are superimposed.
- ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Employer / Owner's Engineer.
- iii) Size of arrow shall be either of the following.
  - a) Colour Bands  
Minimum width of colour band shall be as per approved procedure.
  - b) Whenever it is required by the Employer / Owner's Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden yellow as per IS:2379 shall be painted on the ground colour.

#### IDENTIFICATION OF EQUIPMENT



All equipment shall be stenciled in black or white on each verses, column, equipment after painting as per approved procedure.

#### INSPECTION AND TESTING

- i) 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.
- ii) The painting work shall be subject to inspection 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.

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 Employer / Owner's Engineer 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

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condition of contract. Dry film' thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to Employer.



#### PRIMER APPLICATION

- i. 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 immerse conditions.
- ii. At the discretion of Employer / Owner's Engineer, contractor has to provide the paint manufacturer's expert technical service at site as and when required. For this service, there should not be any extra cost to the Employer.
- iii. Final Inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points / locations as decided by Employer / Owner's Engineer and shall be within + 10% of the dry film thickness.
- iv. The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Employer / Owner's Engineer shall have the right to test wet samples of paint at random for quality. Batch test reports of the manufacturer's, for each batch of paints supplied shall be made available by the contractor.

#### PAINT SYSTEMS

- i. The paint system should vary with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.
  - a) Normal Industrial Environment, Table 2.
  - b) Corrosive Industrial Environment, Table 3
  - c) Coastal & Marine Environment, Table 4

Notes 1. Primers and finish coats for any particular paint systems shall be from same manufacturer in order to ensure compatibility

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**Table – 1 (Colors of Top Coats)**

The colors of top coats in accordance with this specification shall be as follows:

<b>Transmission line block valve accessories</b>		
1.	Above ground valves	:Off White / Blue
2.	Above ground pipes	:Off white
3.	Valve handle	:black
<b>Metering and regulating stations</b>		
1.	Ball valves	:Off white / Blue
2.	Bypass valves	:white enamel (epoxy)
3.	ESD valves / Off take	:Red
4.	Gate vane / Plug valves	:Blue / Grey
5.	Relief valves	:Red / Green
6.	3 way Valve	:Red / blue
7.	Valve actuators	:Red
8.	Valve wheels	:Black
9.	Pipes ( A/G)	:Grey
10.	Meter run(including regulator)	:Grey
11.	Vessels(scrubber/heater)	:Aluminium
12.	Insulating Joint.	:Yellow
13.	K.O.Drum / Filter	:Grey
14.	Pig Launcher / Receiver / flange	: Off White
15.	Fencing	: Aluminium

**Table 2  
Normal Industrial Environment (Above Ground)**



Sl. No.	Description	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	External surface of equipment's and piping.						

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1.1	- do -	-10° C to 20°C	SSPC-SP-3	One coat P-2 50 microns/ coat (min.)	One coat F-4 65 Microns/Coat (Min.) Two coats F-3, 30 Microns/coat (min.)	175	Primer and Finish coat can applied at Ambient temp.
1.2	- do -	21°C to 60°C	SSPC-SP-6	Two coats P-1, 25 Microns/ coat (Min.)	Two coats of F-1, 20 Microns/Coat (min.)	90	-
1.3	- do -	61°C to 80°C	SSPC-SP-6	Two coats P-3, 50 microns / coat (Min.)	Two coats of F-13, 25 Microns/Coat (min.)	150	-
1.4	- do -	81°C to 250°C	SSPC-SP-6	Covered in Finish coat	Three coats of F-11, 20 Microns/Coat (min.)	60	Paint application at ambient temp. curing at elevated temp. during start-up.
1.5	- do -	251°C to 400°C	SSPC-SP-10	Covered in Finish coat	Three coats of F-12, 20 Microns/Coat (min.)	60	- do -

**Table 3**  
**Corrosive Industrial Environment (Above Ground)**



Sl. No.	Description	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	External surface of un-insulated and other equipment						
1.1	- do -	- 10°C to 20°C	SSPC-SP-3	Two coat P-2, 50 microns/ coat(Min.)	Two coat F-3 30 microns / coat(min.)	160	Primer and paint application at ambient temp.

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1.2	- do -	21°C to 80°C	SSPC-SP-10	Two coats P-5, 35 microns / coat(min.)	Two coats F-6, 100 microns/ coat (min.)	270	Paint application at ambient temp.
1.3	- do -	81°C to 400°C	SSPC-SP-3	Covered in finish coat	Three coats F-12, 20 microns /coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours.

**Table 4**  
**Coastal and Marine Environment (Above Ground)**

Sl. No.	Description	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	External surface of equipment's and piping						
1.1	- do -	-10°C to 60°C	SSPC-SP-3	Two coats P-2, 50 microns/ coat (min.)	Two coats F-3, 30 Microns/coat (min.)	160	Primer and Finish coat application at Ambient temp.
1.2	- do -	61°C to 80°C	SSPC-SP-10	Two coats P-5, 35 Microns/ coat (Min.)	Two coats of F-6, 100 Microns/Coat (min.)	270	-do-
1.3	- do -	81°C to 400°C	SSPC-SP-10	One coat F-9, 85 microns / coat (Min.)	-	85	Paint application at Ambient temp.  Primer is acting as primer cum finish coat.
1.4	- do -	i) Upto 80°C	SSPC-SP-10	One coat F-9, 65 microns / coat (Min.)	One coat of F-2, 30 Microns/Coat (min.)	95	Paint application at ambient temp.

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		ii) 81°C to 400°C	SSPC-SP- 10	-do-		85	Paint application at ambient temp.  Primer is acting as primer cum finish coat.
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#### 1.8.4 Precautions to be taken

Neither (the environment of the site, nor the marking labels of devices) may be covered with paint and they must be kept free of paint splashes. To this end it is advisable to use removable masking tape.

Paint splashes, leaks, etc. on any adjacent installations such as measuring apparatus, valves, pipes, sources of light, insulation, heat insulators, walls, concrete, etc. must immediately be wiped up and the damage repaired before the paint is dry.



Otherwise, the Employer / Owner's Engineer will be obliged to have the cleaning carried out at the expense of the Contractor. The paint recipient will only be opened at the time of use (unless otherwise specified by the manufacturer).

The product will be mixed in the recipient with the aid of suitable tools and thus homogenized.

#### 1.8.5 Method of application

Normally, three methods of application will be used on the construction site for the paint products - i.e., with a brush, with a roller or with a spray gun.

- The brush method makes it possible to obtain good penetration of the paint over irregularities in the metal.
- Only (this method will be used for application of the base coats, for retouching and for protrusions, welded areas, riveted joints or bolted joints:
- The roller method may be used on large flat surfaces for (the intermediate and topcoats.
- The spray gun method must be used in accordance with the instructions of the manufacturer and carried out by qualified personnel.

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- The final / finish coat shall be applied with airless spray gun to achieve smooth and glossy finish.

The Contractor must guarantee that all safety measures have been taken for such work. The spray gun method may only be used on site for places that are difficult to reach with the brush. In this case, a request must be made to the Employer / Owner's Engineer for a deviation.

All paint work will be carried out with good brushes or rollers that are suitable for the type of paint being used and for (the form of the material to be painted and fitted with short handles. The maximum length of the brush and roller handles will be 50 cm; longer handles may only be used for places that are absolutely inaccessible. The maximum width of a brush will be 13 cm.



#### 1.8.6 Application of the coating

Application of the paint shall be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The Employer / Owner's Engineer demands that painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

The layers of paint must have a uniform thickness. They must be spread in such a way that all concave parts are dried out and that the surface is completely covered and has a glossy appearance without leaving brush marks and without exhibiting bubbles, foam, wrinkles, drips, craters, skins or gums that arise from weathered paint.

Each layer must have the colour stipulated in the tables of the present specifications, which clearly differs from the previous layer, taking account of the colour of the top layer. All of which for the purpose of being able to identify the number of coats and their order of sequence. If the colour of the coats is not mentioned in the tables the colour difference in consecutive coats must, if possible, be at least 100 RAL. The colour of the top layer is given in the table.



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The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the Employer / Owner's Engineer.

The drying times prescribed by the paint manufacturer must be strictly observed in relation to the environmental conditions before proceeding with the application of the next layer.

The dry coating thickness indicated in the description of the paint systems, are minimum thickness. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thickness specified by the supplier.

#### 1.8.7 Transporting treated items



In the case of works being carried out in a workshop, the metal structures will be surrounded by ventilated contraction film that prevents damage during transportation. This film may only be applied after complete polymerisation of the paint.

### 1.9 GROUND-LEVEL TRANSITION POINT

#### 1.9.1 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 30 cm and a depth of 40 cm. perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over the entire surface area, prepared in accordance with Sa 3:

- 1) The primer of system 01A
- 2) Reinforced polyester  $\pm$  20 cm above the ground level marker and  $\pm$  5 cm on the asphalt cleaned beforehand. (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the

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case of PE, in contrast to asphalt, he will apply a polyken primer to PE immediately before applying the reinforced polyester.

- 3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.
- 4) For new constructions, the polyken primer will be applied to PE and then subsequently processed as described under point 2.

#### 1.10 QUALITY CONTROLS AND GUARANTEE

1.10.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paint work can be carried out within the technical specifications.



The Contractor should have the required calibrated monitoring apparatus for this purpose on site (with calibration certificates). The personnel who will have to use this apparatus should have the training for this purpose.

The Employer / Owner's Engineer may maintain supervision during the works and inspect the works with random checks. A daily report shall be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the Employer / Owner's Engineer do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

#### 1.10.2 Reference Surfaces

At the start of the works, the Employer / Owner's Engineer will indicate a few surfaces that the Contractor will prepare and cover in accordance with the recognized method of operation under the inspection and to the satisfaction of all parties; the Employer / Owner's Engineer or his representative, the approved supervisory body, the contractor and possibly the paint manufacturer. These reference surfaces will serve as a point of comparison for the good adhesion of the paint on the installations as a whole. The parties will together work out a system for the identification of these surfaces in order to be able to monitor the condition of the coatings over time. If the paintwork on a section of the installations is in a worse

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condition than the reference surfaces, the Contractor may be obliged to treat these parts again.

1.10.3 The Employer / Owner's Engineer will use the following standard as a base of assessment of quality

- The Swedish standards ISO 8501-1 1988 SS 05.5900 concerning the degree of cleanliness of the areas de-rusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 or ASTM D1212
- The dry layer thickness of the film will be measured electronically, will complete statistical information, in accordance with ISO 2808 or ASTM D 1186
- The thickness of each layer will be measured in accordance with ISO 2808, ASTM 4138 or DIN 50986
- Adhesion tests will be carried out in accordance with ISO 2409, ASTM 3359 or DIN 53151
- Traction tests will be carried out in conformity with ISO 4624 or ASTM D 4541
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer;
- Any defects in the paint film may be inspected visually by means of a magnifying glass or microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82.



The final judgment of Employer / Owner's Engineer is irrevocable and binding for the Contractor. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by Employer / Owner's Engineer shall be borne by the Contractor.

1.10.4 Guarantee

a) General Principles

The Contractor declares that he is aware of:

- The maximum operating temperature of the surfaces to be covered;

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- The maximum permitted degree of humidity of the bearing surface;
- The properties of the environment to which the surfaces to be covered are subject.

b) Summary of the Guarantee

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paint work regarding, among other things ;
- The preparation of the surfaces;
- The thickness of each layer
- The total thickness of the covering.
- The uniformity of the materials used;
- The repair of all defects before delivery of the works.

The Contractor will carry out the requested repair work as promptly as possible.