

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

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

**ANNEXURE 'A'**

**Material** PROCUREMENT OF 6 INCH SEAMLESS PIPELINE FOR QADIRPUR GAS FIELD.

**Tender Enquiry No** PROC-FB/CB/PROD-4613/2020

**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	PIPE CS SEAMLESS 6", WT 7.11 MM, SCH 40, BE, API 5L, GR. X 52, NS NORMALIZED WITH, COATED W/3 LAYER POLYETHYLENE, NACE MR 0175, DOUBLE RANDOM LENGTH, PSL-2, ANNEXURE 'H'.	Meter	10000					

**Note:** NOTE:1.PAYMENT WILL BE MADE AS PER THE FOREIGN PROCUREMENT PAYMENT TERMS AVAILABLE AT OGDCL WEBSITE (TENDERS TAB).02:PURSUANT TO TENDER CLAUSE # 2.2, 11.4, 13 & 35.3.2, A BID BOND OF USD 8,000/-OR EQUIVALENT IN PAK RUPEES, MUST BE SUBMITTED WITH THE TECHNICAL BID AND IT MUST BE VALID FOR 150 DAYS FROM THE DATE OF OPENING OF THE BID.DELIVERY PERIOD FOR THESE ITEMS IS FOUR (04) MONTHS ON C&F BY SEA KARACHI FROM THE DATE L/C IS ESTABLISHED.

*Hammad Ahmed*  
vetted.

**Hammad Ahmed**  
JE (Mech) PE & FD

**ELIGIBILITY CRITERIA**

Prior to the detailed technical and financial evaluation, pursuant to below mentioned criteria, the OGDCL will determine the eligibility requirements of manufacturers/bidders and goods.

**Eligibility of Manufacturers/Bidders & Goods.**

1. The manufacturer must have current valid API 5L Certificate (PSL II, NS, Annex H). Copy of the certificate to be submitted.
2. The manufacturer must have least last 5 year's API 5L Certificate. Date of tender opening will be considered to calculate Five (05) years requirement of API 5L certificate. The Manufacturer/ Bidder shall submit documentary evidence in form of copies of the certificates.
3. Submission of authority letter of the Manufacturer in favor of the bidder and authority letter of the bidder in favor of the local agent.
4. The Bidders are required to adhere to the maximum Delivery Period of Four (04) months on CFR Karachi by Sea basis, from the date the letter of credit (L/C) is established.
5. The Line Pipe to be supplied under the Contract must be brand new (Certificate to be provided by supplier) and produced in and supplied from the countries maintaining bilateral trade relation with the Islamic Republic of Pakistan.



## TECHNICAL EVALUATION CRITERIA

Technical Evaluation will be carried out in the light of following criteria:

1. Compliance to SOR, Technical Specifications/ Data sheets and Annexures. Bidder to submit signed / stamped copy of the SOR, specifications/ data sheets.
2. The Manufacturer/ Bidder must have supplied Line Pipe in last five (05) years with at least five agreement with value greater than or equal to 0.25 MMUSD to International E&P companies. International E&P companies Should be either an upstream member of International Association of Oil & Gas Producers (IOGP) or Pakistan Petroleum Exploration & Production Companies Association (PPEPCA). The bidder shall submit documentary evidence in form of copies of purchase orders.
3. Submission of Copies of valid ISO (9001 & 14001), API-Q1 and OHSAS 18001 certifications of the manufacturer.
4. Submission of Audited Financial Statements of last 3 consecutive years, of the Manufacturer and the Bidder. In case the reports are not in English Language, then in addition to these printed reports the English translation of the same must also be submitted with the technical bid.
5. Submission of copies of Performance Certificates of material Supplied to International E&P Companies.
6. Submission of Corporate & Financial Information of the manufacturer and the Bidder.
7. Bidders must submit technical literature and brochures of the Manufacturing facility and the quoted material.
8. All above required information should be provided along with the bid, failing which the bid will not be considered for the evaluation.



Spec. No. **4985-PA-2006**

Page **1** of **13**

Rev. **0**


## SPECIFICATION FOR LINE PIPE, SEAMLESS

Project: **Miscellaneous Field Flow line**

Client: **Oil & Gas Development Company Limited**

Prepared by: **AHS**  
Checked by: **AB**  
Approved by: **SC**  
Revised by: **-**

Rev.	Description of Revision	Date	Revised Page Nos.
0	ISSUED FOR BIDDING	August 10, 2017	

  
**SYED ABID HUSSAIN SHAH**  
Principal Technical Officer  
PE & FD (Prod) Ext: 2879

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**1.0 SCOPE**

- 1.1 This specification covers the design, materials, manufacture, testing, identification, documentation, and shipping requirements of seamless pipe, that is resistant to hydrogen-related damage, for sour gas transmission service.
- 1.2 The purchase order shall state the grade, outside diameter, wall thickness, weight per linear foot, specified minimum yield strength, the applicable manufacturing specification and the total footage of the required pipe.
- 1.3 The written specification is an integral part of the purchase order on which it appears. Any additional requirements, changes, or addenda to this specification shall be as agreed upon in writing and also become a part of the Purchase Order.
- 1.4 Within this specification the following definitions shall apply: -

“Company” means “Oil and Gas Development Company Limited (OGDCL)”

“Engineering Consultant” shall mean “OGDCL”

“Supplier” means Entity with whom the Company will execute a Contract for supply of equipment/material as per this document

“Project” means “Gas Field Development”

**2.0 DESIGN REQUIREMENTS**

- 2.1 The required length of each joint shall be double random length with no length shorter than thirty (30) feet and no length longer than forty-one (41) feet. The minimum average length shall be thirty-six (36) feet.
- 2.2 No jointers (two pieces of pipe welded together to make a standard length) shall be acceptable.
- 2.3 All tolerances on dimensions and weights shall conform to the requirements of API-5L.
  - 2.3.1 Pipe shall not deviate from a straight line by more than 5/8 inch per joint or a proportional amount in any shorter length.
  - 2.3.2 Each joint of pipe regardless of diameter, shall be checked for out-of roundness in accordance with API-5L. The use of jacks to achieve the above criteria is prohibited.
  - 2.3.3 For pipe with a specified outside diameter greater than 20" the actual outside diameter shall not be more than 3/32" greater than the specified outside diameter not more than 1/32" less than the specified outside diameter as measured with a diameter tape.



**3.0 MATERIAL**

If steel is supplied by a third party, the source of the steel shall be furnished to the Company/Engineering Consultant and all provisions of this specification shall be followed including all rights of inspection.

**3.1 Quality:**

All materials used in the manufacture of pipe shall be manufactured in accordance with good industry practice and shall conform with the requirement of API-5L.

**3.2 Chemical Properties and Tests:**

**3.2.1** The Supplier shall furnish the Company/Engineering Consultant the chemistry to be aimed for in the steel to be used for pipe on this order prior to the pipe supplier all pipe shall be manufactured from fully killed, desulfurized steel with inclusion shape control.

1. This chemistry, as determined by the ladle analysis and the permissible variations for check analysis shall be as agreed upon between Company/Engineering Consultant and Supplier. The proposed chemical composition, a detailed procedure for inclusion shape control and representative test data from previous production substantiating the resistance of the proposed chemical composition to hydrogen related damage, shall be submitted to the Company/Engineering Consultant with the quotation,

2. The carbon equivalent based on the check analysis shall be agreed upon between the Company/Engineering Consultant and Supplier but shall not exceed 0.42% based on the following formula. A chemical analysis of elements in the formula shall be furnished by the Supplier.

$$CE=C+Mn/6+(Cr+Mo+V)/5+(Ni-t-Cu)/15$$

3. The Supplier shall furnish a ladle analysis and at least on check analysis form each heat of steel used in the production of pipe under this specification.

**3.3 Mechanical Properties and Tests:**

**3.3.1** All mechanical testing shall be performed according to the frequency and orientation required in API Spec. 5L.

**3.3.2** For pipe purchases involving 10 or more heats of steel, a yield strength restriction shall apply whereby 80% of the heats shall have maximum yield strength of 15 KSI over the SMYS and the maximum yield strength of the remaining heats shall not exceed the SMYS by more than 20 KSI.

**3.3.3** Each tensile test specimen shall be hardness tested using Rockwell, Brinell, or Vickers test methods. The hardness shall not exceed 22 Rockwell C, or the equivalent based on conversion of other methods in accordance with ASTM E 140.

**3.3.4** The Supplier shall conduct charpy impact tests in the body of the mill pipe in accordance with API Spec 5L SR5 at +32 °F. The largest possible transverse specimen size shall be used in accordance with Table SR5.1 except that the largest possible longitudinal specimen size shall be used when Table SR5.1 indicates that the

pipe size is insufficient to obtain 1/2 size transverse specimens. The shear area appearance of these tests must achieve 85% minimum average shear area for all heats. 65% minimum shear area for any single test. The minimum energy value to be achieved in full size specimens shall be 25 ft-lbs. with adjustments for sub-size specimens in accordance with SR5.

**4.0 MANUFACTURING AND FABRICATION REQUIREMENTS**

- 4.1 The manufacturing procedure and quality assurance program shall be provided by the manufacturer with the quotation.
- 4.2 Cold expansion shall not be allowed.
- 4.3 Surface irregularities caused by the straightening machine shall be minimized.
- 4.4 Weld repair of defects is prohibited.





**5.0 TESTING**

- 5.1 Hydrostatic Testing:
- 5.1.1 The hydrostatic test shall be as specified in API-5L and shall be held for a minimum of ten (10) seconds.
  - 5.1.2 The Supplier shall make available to the Company/Engineering Consultant the most recent certifications of calibration of the pressure gauges and recorders.
  - 5.1.3 The minimum hydrostatic test pressure shall be as per API 5L latest edition. Each length of pipe shall be inspected for localized yielding after the hydrostatic test and any length of pipe with localized yielding shall be rejected.
  - 5.1.4 The Supplier shall maintain a record of each joint being hydrostatically tested. The record shall indicate the joint number, test pressure and duration. This record shall be provided to the Company/Engineering Consultant's representative.
- 5.2 Non Destructive Testing:
- 5.2.1 A copy of all non-destructive testing procedures shall be made available to the Company/Engineering Consultant prior to start of production.
  - 5.2.2 All non-destructive testing required by API Spec.5L latest edition and this specification shall be performed by experienced and skilled personnel certified as level-II or III inspectors in accordance with ASNT's recommended practice SNT-TC-1A.
  - 5.2.3 The Supplier shall provide a report showing the results of all nondestructive testing to the Company/Engineering Consultant representative at the end of each turn. This report shall indicate the number of joints tested as per non-destructive testing method, including the joint number, discontinuities locating the disposition of each joint and the initials of the individual conducting the test of each joint.
  - 5.2.4 All non-destructive testing equipment shall be calibrated a minimum of two (2) times per turn (eight-hour shift) and after any extensive shutdown at the discretion of the Company/Engineering Consultant representative.
  - 5.2.5 A magnetic particle or ultrasonic inspection shall be performed one inch back from the bevel on both ends of each length of pipe to examine for mid-wall laminations. Magnetic particle examination shall only be performed on milled bevel surfaces.
  - 5.2.6 Full body ultrasonic inspection shall be performed on each length of pipe in accordance with API Spec 5L latest edition.
  - 5.2.7 The Supplier shall maintain a record of each joint being ultrasonically tested. The record shall indicate the joint number. This record shall be provided to the Company/Engineering Consultant's representative.
- 5.3 Hydrogen-Induced Cracking (HIC) Tests:
- Specimens from one pipe length per heat shall be tested in accordance with NACE

Standard TM0284 using the test solution specified in NACE Standard TM0177 - Method A. The acceptance criteria shall be as follows:

Maximum Crack Length Ratio (CLR) = 5%  
Maximum Crack Sensitivity Ratio (CSR) = 1%

5.4 Measurement of Residual Magnetism:

If electromagnetic inspection or pipe handling equipment is used. Random measurements for residual magnetism subsequent to inspection and handling shall be conducted, as follows:

- 5.4.1 Measurements shall be made with a calibrated Hall-effect gauss meter or other calibrated instrument approved by the Company/Engineering Consultant.
- 5.4.2 Measurements shall be made on the ends of at least three pipes per turn (8-hour shift). One pipe shall be measured from the beginning, middle, and end of each turn. The results shall be recorded and reported to the Company/Engineering Consultant.
- 5.4.3 As a minimum, four readings shall be taken around the circumference of each end of the pipe. The average of the four readings shall not exceed 15 gauss and no single reading shall exceed 20 gauss.
- 5.4.4 Any pipe exceeding the requirement shall be considered defective. Pipe produced between the defective pipe and the last acceptable pipe shall be measured. If the pipe production sequence is documented, pipe may be measured in reverse sequence until at least three pipes met the requirements, pipe produced after the defective pipe shall be measured until at least three consecutive pipes meet the requirements.
- 5.4.5 All defective pipes shall be demagnetized full length and re-measured or rejected.



**6.0 INSPECTION**

**6.1 Acceptability**

6.1.1 The manufacturing, testing, and loading of the pipe shall be inspected by Company/Engineering Consultant. All pipes that do not comply with this specification shall be rejected and replaced with pipe that does comply at the Supplier's expense.

6.1.2 The Supplier shall be liable for any replacement costs of pipe furnished under this specification that fails, as a result of pipe imperfections and mill workmanship/under the initial field hydrostatic testing as per API 5L latest edition. The Company/Engineering Consultant will seek reimbursement for replacement costs when the failure is solely because of mill imperfections. Replacement costs shall be based on the actual cost of the pipe and the supplier's cost of personnel and equipment required to locate, remove and replace the failed segment of pipe.

6.1.3 If a failure occurs, the segment of pipe containing the failure shall be located, removed, and replaced. The segment of the pipe containing the origin of the failure shall be sent to an outside consultant for analysis. The Company/Engineering Consultant will notify the Supplier of the failure and shall give the Supplier sufficient notice of rescheduled commencement of hydrostatic testing to permit the Supplier to have a representative present during the testing if the Supplier so desires.

6.1.4 NA.

6.1.5 Bidder to submit manufacturing schedule with the bid in order arrange third party inspection during manufacturing process. All cost related to 3<sup>rd</sup> party will be borne by OGDCL.

**6.2 Notification**

The Supplier shall notify the Company/Engineering Consultant five (5) days prior to manufacturing inspection, testing, loading for shipment, and shipment unless otherwise agreed upon at the time of purchase. Inspections, tests or activities identified in the Company/Engineering Consultant's Quality Plan as a Hold Point shall not be conducted without the presence of the Company/Engineering Consultant.

**6.3 Plant Accessibility**

At any time during the period that work on the contract with a Company/Engineering Consultant & Supplier is being performed, the inspector(s) representing the Company/Engineering Consultant, upon giving the supplier prior notification, shall have access to all parts of the supplier's facilities relevant to the contract. All reasonable requests shall be granted to the inspector (s) to enable verification of compliance with this specification.

**6.4 Inspection by the Company/Engineering Consultant**

The monitoring and witnessing of inspections and tests by the Company/Engineering



Consultant shall be in accordance with the Quality Plan. The Company/Engineering Consultant reserves the right to increase or decrease the level of inspection based on performance during production.

## **7.0 IDENTIFICATION**

### 7.1 Type and Location of Identification

7.1.1 Identification markings shall be stenciled with paint on the pipe. Die stamping shall not be used.

7.1.2 The markings shall be located on both ends of each length of pipe on the exterior surface.

### 7.2 Information Required

7.2.1 Identification markings shall be in accordance with API-5L PSL2.

## **8.0 HANDLING OF PIPE**

### 8.1 Racking of Externally Uncoated Pipe in manufacturer's Yard.

8.1.1 All equipment for handling pipe shall be free of contaminants which may adversely affect coatings. All handling equipment for coated pipe shall be adequately padded to prevent damage to the pipe or coating. Sling hooks shall be lined with an aluminum or phenolic liner.

8.1.2 All Pipes shall be separated by size, wall thickness, and grade.

8.1.3 Externally uncoated pipe shall be racked in snug rows and tiers with a minimum space between joints, in a manner that will prevent damage to the pipe, and in accordance with the following

1. All welds, longitudinal, double joint, etc. shall be staggered to avoid weld-to-weld and weld-to-pipe contact.
2. The entire bottom row of pipe shall be elevated not less than 4" off the ground on earth berms covered with polyethylene sheeting or on a sufficient number of padded timber skids, properly spaced and leveled to support the pipe without damage.
3. The bottom row of pipe shall be restrained to prevent the pipe joints from rolling.

### 8.2 Racking of Externally coated Pipe in Supplier's Yard.

8.2.1 The externally coated pipe shall not be racked until the coating has cooled to the extent to support the weight of the pipe.

8.2.2 Each joint of externally coated pipe shall be separated from each adjacent joint by not less than three ¾" polypropylene rope collars shall not exceed 20 feet.

8.2.3 The supplier shall furnish all supervision, labor, materials, equipment, and services necessary for the racking of the pipe.



**9.0 SHIPPING**

- 9.1 No Pipe shall be shipped until the respective physical tests have been completed with acceptable results.
- 9.2 All pipes shall be visually inspected and counted by both the Company/Engineering Consultant and Supplier upon receipt, and this record shall be deemed to indicate the amount of pipe delivered to the Supplier by the Company/Engineering Consultant.
- 9.3 All equipment for handling pipe shall be adequately padded to prevent damage to the pipe. The padding must have the Company/Engineering Consultant's approval prior to loading the pipe.
- 9.3.1 Sling hooks shall be lined with an aluminum or phenolic liner.
- 9.3.2 Pipe retainers, if used, must be padded, and tie-down apparatus will be nylon straps only.
- 9.3.3 Trailer wheels of conveyance must be fitted with gravel guards in condition as required by (aw to prevent gravel impact damage and the accumulation of mud and road oil on the pipe.
- 9.4 Flat bed trailers on which pipe are loaded must be of the proper length to prevent overhang. Overhang is not permitted unless approved by the Company/Engineering Consultant, and in no case should overhang exceed 4 feet beyond the end of the trailer for bare pipe or 2 feet beyond the end of the trailer for coated pipe.
- 9.4.1 Prior to loading pipe, four (4) bearing pieces are to be placed on the bed of the trailer. Each bearing piece consists of an 8' long piece of 4" x 4" or 2" x 6" hardwood lumber in good condition with an 8" long, 4" x 4" or 6" x 6" angle block nailed to each end at the appropriate location to accommodate the applicable pipe size, for pipe spacing and stability. Bearing pieces are to be oriented transverse to the pipe and spaced evenly beneath it.
- 9.4.2 Four separators should be used between each row when pipe is not nested. Separators consist of 2"x4" or 2"x6" hardwood lumber in good condition with 4"x4" or 6"x6" angle blocks nailed on top and bottom at each end for pipe spacing and stability. Separators are to be oriented transverse to the pipe and spaced evenly along it.
- 9.4.3 Each length of; pipe shall be separated from each adjacent length by not less than three 3/4" polypropylene rope collars, one near each end and one in the middle. In the case of triple random length pipe, a minimum of 5 polypropylene rope collars will be required, spaced evenly along each joint. Collar spacing shall not exceed 20 feet.
- 9.5 Pipe will be loaded in layers and will not be nested in pyramid fashion unless specifically authorized by the Company/Engineering Consultant.
- 9.5.1 Pyramiding of Pipe, while an acceptable industry standard, is not recommended by the Company/Engineering Consultant. Layer loading provides a much more stable loading condition and is therefore the Company/Engineering Consultant standard.
- 9.5.2 Pyramiding of pipe is acceptable however in certain conditions such as the following:
1. The transport of bare pipe over short distances.
  2. The short distance transport of coated pipe between rail sidings or marine ports and job site locations.



3. The short distance transportation of coated pipe between a pipe coater's location and a rail loading site or marine port.
- 9.5.3 In all cases, coated pipe being loaded in pyramid fashion must be fully protected from contact with adjacent pipe joints through the use of the required number of polypropylene rope collars and secured properly to the transporting conveyance.
- 9.6 The transportation by rail of both coated and bare pipe shall in all cases comply API recommended practice, RP 5L1, "Recommended Practice for Railroad Transportation of Line Pipe."
- 9.7 Marine shipment shall be loaded in accordance with API-RP 5LW, "Recommended Practice for Transportation of Line pipe on Barges and Marine Vessels," and the following:
  - 9.7.1 The pipe is to be stored in a manner and in a location to prevent damage to it and/or its coating. The pipe's location should be such that the pipe shall be undisturbed until it is unloaded. The bottom row of pipe shall be cushioned against the deck prior to placing the pipe.
  - 9.7.2 No cargo of any nature shall be stored on top of the pipe or against the sloping sides of the coated pipe.
  - 9.7.3 Each length of pipe shall be separated from each adjacent length by not less than three 3/4" polypropylene rope collars, one near each end and one in the middle. Collar spacing shall not exceed 20 feet.
- 9.8 In addition to the steel bands used to unitize bundles of small diameter pipe. Nylon straps or equivalent shall be used on all shipments of such pipe bundles, bare or coated, to prevent movement.
  - 9.8.1 The nylon straps shall be brought up over the pipe bundles and fastened down. A combined total width of twenty (20) inches of nylon strapping shall be used on each load. The twenty (20) inches of strapping shall consist of five (5) 4" -wide straps or ten (10) 2" wide straps.
  - 9.8.2 Rubber padding or other suitable padding shall be used to protect the pipe bundles, bare or coated, from the binder chains, when binder chains are approved for use
- 9.9 Any pipe damaged by Supplier shall be repaired in accordance with Company/Engineering Consultant's pipe specifications and applicable API Standards. Pipe damaged beyond permissible repair and any pipe heated in excess of 750°F shall become the property of Supplier and Supplier shall reimburse Company/Engineering Consultant the total value of such Pipe.
- 9.10 Spider grinding shall be an acceptable method of bevel repair at the external coating plant. The bevel repair shall be in accordance with API 5L and as follows:
  - 9.10.1 Pipe ends beveled to an angle of 30° (+5°; -0°).
  - 9.10.2 Bevel shall have a 1/16" root face.
  - 9.10.3 Bevel shall be square cut in accordance with API 5L latest edition.
- 9.11 Pipe shall be adequately padded to prevent weld-to-weld and weld-to-pipe contact. All welds,



longitudinal, double joint, etc. shall be staggered so that they do not oppose each other on adjacent pipe.

- 9.12 The Supplier shall furnish all supervision, labor, materials, equipment and services necessary for the loading of the pipe.
- 9.13 The Supplier, at the end of each day, shall provide a tally of each conveyance loaded certifying the number of joints loaded, total footage and weight per conveyance.

#### **10.0 RECORDS**

- 10.1 Three (3) copies each of the certified mill test reports on all pipe under this specification shall be mailed to the Company/Engineering Consultant. Certified mill test reports shall be meet all requirements shown in API SR-15.
- 10.2 Each report shall be identified by the purchase order number, grade, and pipe size and heat number
- 10.3 The subject reports shall be mailed within ten (10) days after shipment as specified in the purchase order.

#### **11.0 REFERENCES**

All pipes shall be manufactured in accordance with this specification and the current editions of the following codes, standards, and specifications, as applicable.

- |      |                |  |
|------|----------------|--|
| 11.1 | API-RP 5L1     | Recommended Practice for Railroad Transportation of Line pipe.   |
| 11.2 | API-RP 5LW     | Recommended Practice for Transportation of Line pipe on Barges and Marine Vessels.                       |
| 11.3 | NACE TM-0284   | Evaluation of Pipeline Steels for Resistance to Stepwise Cracking.                                       |
| 11.4 | NACE TM-0177   | Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in H <sub>2</sub> S Environments. |
| 11.5 | ASTM E-140     | Standard Hardness conversion Tables for Metals   |
| 11.6 | ASNT SNT-TC-1A | Recommended Practice for Personal Qualification and Certification in Nondestructive Testing              |

**12.0 QUALITY PLAN**

<u>Activity</u>	<u>Company/Engineering-Consultant Inspection</u>	
Pre-production Meeting		H
Pipe Supplier	M	
Nondestructive Inspection (Calibration)	H	(See Note)
Nondestructive Inspection (Production)	H	(See Note)
Flattening Tests	M	
Tensile Tests		H
Impact Tests		H
Hardness Tests	H	
Dimensional Inspection	H	
Visual Inspection		M
Marking & I.D		H
Residual Magnetism Measurement	M	
Loading		M
HIC Testing		R
MTR		R

Note: The inspections/tests are considered "hold points" at the beginning of production and may be changed to Monitor Points based on production performance if notified in writing by the Company/Engineering Consultant.

- H - Hold Point, inspection or testing shall not proceed without the presence of Company/Engineering Consultant.
- M - Monitor Point, notification to the Company/Engineering Consultant of impending inspection or test activity is required.
- R - Review Documentation, presentation of the specified documentation to the Company/Engineering Consultant is required.

**12.1 MANUFACTURING SITE VISIT/ PROJECT KICK OFF MEETING**

After the award of contract, the supplier/manufacturer would arrange a five days Visit (excluding travel time) of an OGDCL team comprising three professionals (Two engineers from technical department and One Official from SCM department) to manufacturing site. All the expenses for arrangement including Visa Processing Charges, Return Air Ticket, Inland foreign country travel, Boarding, lodging & Transportation will be borne by bidder/manufacturer.

The agenda would comprise Project Kick Off, project QA/QC review, TPI scope finalization and techno/commercial capabilities of manufacturer demonstration/review etc.






Job No.	
Spec. No. <b>4985-PA-2008</b>	
Page <b>1</b> of <b>25</b>	Rev. <b>0</b>

# SPECIFICATION FOR THREE LAYERS POLYETHYLENE PIPE COATING

Project: **Miscellaneous Field**

Client: **Oil & Gas Development Company Limited**

Prepared by: **AHS**  
 Checked by: **AB**  
 Approved by: **SC**  
 Revised by: **-**

  
**SYED ABID HUSSAIN SHAH**  
 Principal Technical Officer  
 PE & FD (Prod) Ext: 2879

Rev.	Description of Revision	Date	Revised Page Nos.
0	ISSUED FOR BIDDING	August 10, 2017	

## **CONTENTS**

### **1.0 GENERAL**

#### **1.1 Scope**

1.1.1 This Specification defines the supply and application of 300 – 400 microns Fusion Bonded Epoxy (FBE) Corrosion Protection Coating, 300 – 400 microns intermediate layer of copolymer adhesive and 2000 microns outer polyethylene coating to steel line pipe. The pipe shall be supplied in double random length and in accordance with Specification No. 4985-PA-2006.

1.1.2 The Supplier shall be responsible for ensuring that the materials utilized are suited for the design life of 50 years.

1.1.3 All inspection and certification shall be undertaken by a third party certification body approved by the Company. In addition to the third party certification, Company may also appoint its own inspector for the witnessing/inspection of coating application and tests.

#### **1.2 Definitions**

“Company” means “Oil and Gas Development Company Limited (OGDCL)”

“Engineering Consultant” shall mean “OGDCL”

“Supplier” means Entity with whom the Company will execute a Contract for supply of equipment/material as per this document

“Project” means “Miscellaneous Field Development”

#### **1.3 Errors or Omissions**

1.3.1 The review and comment by the Company/Engineering Consultant of any Supplier’s or its manufacturer’s drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the Supplier of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the Supplier in this Specification shall be immediately brought to the attention of the Company/Engineering Consultant.

#### **1.4 Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the Company/Engineering Consultant before issuing the



procurement document. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the Company/Engineering Consultant prior to execution of the work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, Codes & Standards referenced in this Specification or any other documents, the Supplier shall refer to the Company whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the Company/Engineering Consultant and the Supplier for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. Supplier's manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by Company/Engineering Consultant.

1.6.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the Company/Engineering Consultant.

2.0 **CODES, STANDARDS AND SPECIFICATIONS**

The materials and equipment supplied and work performed under this Specification shall conform to the latest edition of the industry Codes and Standards, references recommended practices and project specification listed below:

ANSI B31.8	Liquid Petroleum Transportation Piping Systems
ISO 9000/9001/9002	Quality Systems
API Spec. 5L	Specification for Line Pipe
API RP 5L1	Recommended Practice for Railroad Transportation of Line Pipe.
API RL 5L5	Recommended Practice for Marine Transportation of Line Pipe.
ASTM E 337	Test for Relative Humidity by Wet & Dry Bulb Psychrometer.
ASTM C177	Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate



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ASTM C518	Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter
ASTM D-1621	Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D 1622	Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D1623	Test Method for Tensile Properties of Rigid Cellular Plastics
ASTM D2126	Test Method for Response of Rigid Cellular Plastics to Thermal & Humid Aging
ASTM D2856	Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Psychrometer.
ASTM G8	Cathodic Disbonding of Pipeline Coatings.
NACE RP-02-74	Recommended Practice, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
NACE RP-01-88	Discontinuity (Holiday) Testing of Protective Coatings
SSPC-SP-1	Solvent Cleaning
SSPC-SP-10	Mechanical Cleaning
SSPC-AB-1	Mineral and slag abrasive
SSPC-PA-2	Measurement of dry coating thickness.
SSPC-VIS-1	Visual standards for abrasive blast cleaned steel
DIN 30670	Polyethylene Coating Pipe for Steel Pipes & Fittings
4985-PA-2006	Line Pipe Material
4985-DS-1801	Heat Shrinkable Sleeves for 3-Layer Polyethylene Coated Pipe Weld Joints, Pipe Bends, and Coating Damages.



### **3.0 QUALITY PROGRAM**

A quality control program shall be submitted to the Company for review and approval prior to first production. The program shall be in accordance with ISO 9000/9001/9002 as the appropriate standard.

The quality program shall, minimum, include the following:

- a) Raw material handling procedures
- b) Surface preparation procedure
- c) Raw material testing
- d) Coating application procedures
- e) Inspection & testing of coating procedures
- f) Inspection & testing equipment calibration
- g) Coating repair procedures
- h) Handling & stockpiling
- i) Personnel qualification



Sr. No	Description	Compliance by 3LPE coating mill
<b>4.0</b>	<b><u>DESIGN REQUIREMENTS</u></b>	
4.1	The normal pipe cover is 1.0 – 2.0 meters of soil. At various crossings and at other topographical features the cover will be increased beyond 2 meters up to a maximum of 7.0 meters soil cover at the worst case river crossing.	
4.2	The FBE, intermediate layer of copolymer adhesive and outer polyethylene coating shall be capable of withstanding a maximum continuous operating temperature (i.e. design temperature) of 140°F.	
4.3	The FBE, intermediate layer of copolymer adhesive and outer polyethylene coating shall be capable of withstanding the cyclic operating temperature range between 85°F and 130°F over the design life, and minimum ambient temperatures of 30°F.	
4.4	The FBE, intermediate layer of copolymer adhesive and outer polyethylene coating thickness shall be not less than the minimum thickness shown in article 6.1, 6.2 and 6.3 of this specification.	
4.5	The FBE, intermediate layer of copolymer adhesive and outer polyethylene coating pipe shall be installed using conventional lifting and laying equipment.	
4.6	The design life of all the coatings shall be 50 years.	
4.7	Supplier shall, at the time of bidding, state and guarantee the maximum interfacial shear stresses between the FBE and outer polyethylene coating before failure can occur on the coated pipe for evaluation and acceptance by the Company.	
4.8	Coating system shall withstand the operating and construction conditions like rocky, water immersed, sandy etc. and soil conditions.	

Sr. No	Description	Compliance by Line Pipe Manufacturer
<b>5.0</b>	<b><u>QUALIFICATION REQUIREMENTS</u></b>	
<b>5.1</b>	<b><u>Coating Procedure Specification</u></b>	
5.1.1	A detailed coating procedure shall be prepared by the manufacturer for qualification and Company's/Engineering Consultant approval not later than 02 weeks prior to commencement of coating application.	
5.1.2	The Company may appoint its own inspector to witness the production of test pipes and related inspection and testing.	
5.1.3	The coating procedure shall be qualified by coating five double random lengths of line pipe in strict accordance with the coating procedure and this Specification.	



Sr. No	Description	Compliance by Line Pipe Manufacturer
5.1.4	The Supplier may choose to use first day production tests for purposes of qualification.	
5.1.5	The Supplier shall submit certified records of all aspects of the qualification procedure to the Company for approval.	
5.1.6	Any failure to meet any part of the qualification procedure shall require the Supplier to revise the procedure and repeat the qualification process.	
5.2	<b>General</b>	
	The coating procedure shall address the following points as a minimum:	
5.2.1	Before commencement of the coating works at the factory, the manufacturer shall submit a detailed procedure for Company's approval to qualify the coating application and testing / inspection procedure.	
5.2.1.1	Line pipe handling, storage and inspection at all stages of application work.	
5.2.1.2	Complete details of the coating materials together with quality control, storage of materials, Manufacturer's certification and safety sheets. Manufacturer's certification shall cover all characteristics specified in Article 6.1, 6.2 and 6.3.	
5.2.1.3	Application of FBE coating, intermediate copolymer adhesive and outer polyethylene coating including details of thickness, density, thermal conductivity, compressive and shear strengths, bonding strengths and details of application equipment. Coating mill to provide all this information.	
5.2.1.4	Rise and gel times, core temperature, and methods for the FBE as appropriate.	
	Inspection & testing including instrument and equipment types, frequency and acceptance criteria.	
	Details of instrument and equipment calibration methods including relevant standards and examples of calibration certificates.	
	Complete details of inventory of laboratory and testing equipment.	
	Coating repair procedures and acceptance criteria for repair and rejection.	
	First Day Production Tests	
	Shop testing.	



## Specification for Three Layer Polyethylene Coating

Sr. No	Description	Compliance by 3LPE Coating Mill	
6.0	<b><u>MATERIALS</u></b>		
	The coating material shall meet the following characteristics:		
6.1	<b><u>Fusion Bonded Epoxy (FBE)</u></b>		
	<b>Property</b>	<b>Standard</b>	<b>Value</b>
6.1.1	Coating Thickness (Nominal)		300~400 microns
6.1.2	Powder Density		1450 kg/m <sup>3</sup>
6.1.3	Elongation	ASTM 2370	6%
6.1.4	Hardness (1/8" Ball, 100 kg load)		48 - 50 Rockwell
6.1.5	Water Absorption at 65°C	ASTM D570	3% weight basis
6.1.6	Impact Resistance	ASTM G-14 – 72	18J @ 25°C
6.1.7	Abrasion Resistance	ASTM D-1044	0.198 grams weight loss/ 1000 gm wt; 5000 cycles
6.1.8	Shear Adhesion	ASTM D-1002	185 kg/cm <sup>2</sup>
6.1.9	Tensile Strength	ASTM D-2370	40 MPa @ 45°C
6.1.10	Dielectric Strength	ASTM E-149	48±8 Volts/micron
6.2	<b><u>Intermediate Co-polymer Adhesive Layer</u></b>		
	<b>Property</b>	<b>Standard</b>	<b>Value</b>
6.2.1	Coating Thickness		300-400 microns
6.2.2	Melt Index	ASTM D 1238 19°C/2.16 kg	1.0 - 2.0 g/10 min.
6.2.3	Density	ASTM D 1505	0.92 - 0.93 g/cm <sup>3</sup>
6.2.4	Vicat Softening Point	ASTM D 1525	90°C (min.)
6.2.5	Melting Point	DSC	110°C (min.)
6.2.6	Ultimate Tensile Strength	ASTM D 638 @ 50 mm/min.	18 MPa (min.)
6.2.7	Elongation (Ultimate)	ASTM D 638	600% (min.)
6.3	<b><u>Outer Polyethylene Coating</u></b>		
	<b>Property</b>	<b>Standard</b>	<b>Value</b>
6.3.1	Coating Thickness		2000 microns
6.3.2	Density	ASTM D 1505	950 kg/m <sup>3</sup>
6.3.3	Melt Index	ASTM D 1238	0.25 - 0.45
6.3.4	Tensile Stress @ 50 mm/min.)	ASTM D 638	18 MPa
6.3.5	Elongation	ASTM D 638	600% min.
6.3.6	Vicat Softening Point	ASTM D 1525	120°C
6.3.7	Melting Point	DSC	120 (min.)
6.3.8	Oxidative Induction Time in Oxygen @220°C, Alum Pan	ASTM D 3895	15 minutes (min.)
6.3.9	Hardness (Shore D)	ASTM D 2240	60 (min.)
6.3.10	Stress Cracking Resistance	ASTM 1693 Condition B (F50)	300 Hours



## Specification for Three Layer Polyethylene Coating

Sr. No	Description			Compliance by 3LPE Coating Mill
6.3.11	Moisture Absorbency	ASTM D1693	0.01% max.	
6.3.12	Carbon Black Content	ASTM D 1603	1.8 - 2.2 %	
6.3.13	Dielectric Breakdown Voltage		30kV (min.)	
6.3.14	Creep number		0.8 to 1.7 g/10mm	
6.3.15	Temperature resistance		-2°C to +60°C	
6.3.16	Low Temperature brittleness		Less than - 50°C	
6.3.17	Electrical Insulation resistance		Over 10 <sup>8</sup> ohm m <sup>2</sup>	
6.3.18	Carbon Black Particle		Less than 25 micron.	

Sr. No	Description	Compliance by 3LPE coating mill
<b>7.0</b>	<b><u>COATING APPLICATION</u></b>	
<b>7.1</b>	<b><u>Surface Preparation</u></b>	
7.1.1	Pipes shall be inspected from a corrosion standpoint in accordance with SSPC-VIS 1. Pipes in conditions A and B only shall be accepted and any pipe in condition C or D shall be rejected.	
7.1.2	The external surface of the pipe shall be cleaned of all oil, grease, moisture, or other hydrocarbon contaminants, and other atmospheric condition and paint by the Supplier prior to abrasive cleaning. A solvent shall be used in accordance with SSPC-SP-1	
7.1.3	A salt meter approved by the Company/Engineering Consultant shall be used to carry out salt tests before washing and after blast cleaning (after first blast if two blast system is used). One test shall be carried out at each end and one at the center of the pipe. The frequency of the salt tests shall be agreed between the Supplier and the COMPANY/ENGINEERING CONSULTANT.	
7.1.4	The salt test meter shall be calibrated and used in accordance with Manufacturer's recommendations and the acceptance criteria shall be 2 micrograms/cm <sup>2</sup> or less.	
7.1.5	During sandblast cleaning process, ends of the pipes should be protected by plugs, in order to prevent entry of foreign or abrasive particle into the pipe.	
7.1.6	Each length of pipe shall be uniformly heated to at least 60°C to completely remove all moisture and to prevent any condensation of moisture on the pipe, and prior to after abrasive cleaning. The temperature of the substrate shall be a minimum of 5.5°F above the dew point during surface preparation, application and drying. The temperature, dew point, and relative humidity shall be determined with a sling Psychrometer or other approved equal following procedures in ASTM E-337. Readings shall be taken at the start of work and every four (4) hours thereafter. Preheated pipe temperatures shall not exceed 150 °F. Any abrasive entering the pipe shall be removed prior to coating	

Sr. No	Description	Compliance by 3LPE coating mill
7.1.7	The exterior pipe surface shall be abrasive cleaned to a "near white metal finish" Class SA 2.5 using steel grit or dry sand as described in SSPC-SP-10 to remove all dirt, mill scale, rust, corrosion products, oxides, paint and other foreign and deleterious matter. The compressed air for cleaning shall be free of water and oil. Adequate separators, filters, or traps shall be provided.	
7.1.8	The abrasive working mix shall be selected to produce an anchor pattern profile of not less than 0.050 mm and not greater than 0.100 mm.	
7.1.9	The abrasive will be G24 to G50 grit to provide the specified anchor pattern	
7.1.10	The blast cleaned surface shall not be contaminated with dirt, dust, metal particles, hydrocarbons, water, chlorides, surface or any other foreign matter which would be detrimental to the coating. In cases where pipes were varnished/coated for temporary protection, pipe shall be checked with magnifying glass (X30) to confirm that no residues of varnish/coating remain in the anchor pattern valleys.	
7.1.11	Prior to the coating application, the exterior surface shall be thoroughly inspected under adequate lighting. All surface imperfections such as slivers, scabs, burrs, gouges and sharp edges/defects etc. shall be completely removed by grinding. Pipes with ground areas greater than 25 mm in diameter shall be re-blasted.	
7.1.12	Pipe lengths containing a dent shall be set aside for the COMPANY/ENGINEERING CONSULTANT representative to determine its disposition. Gouges or dents shall not be ground without COMPANY/ENGINEERING CONSULTANT approval.	
7.1.13	No grinding shall be permitted which reduces the wall thickness of the pipe below the minimum permitted for a new pipe as specified in design specification.	
7.1.14	All blast cleaned pipes shall be checked for dust, freedom of oil chlorides and anchor pattern.	
7.1.15	The abrasive working mix shall be maintained clear of contaminants by a continuous and effective operation of the abrasive machine scalping and air wash separators.	
7.1.16	After cleaning and prior to coating, cleaned pipe shall be inspected by manufacturer under ample lighting conditions to ensure that all the cleaning steps have been adequately performed.	
7.1.17	The abrasive cleaned surface shall not be contaminated with dirt, dust, metal particles, oil, water, or any other foreign matter from any source, nor shall the anchor pattern be destroyed or burnished by pipe transport systems, processing equipment, tools, or follow-up cleaning with abrasive sanders.	
7.1.18	Following abrasive cleaning and prior to the coating application, all dust, grit, metal particles or other loose contaminants remaining on the surface or entering the interior of the pipe shall be blown off with clean, dry, oil-free compressed air in a manner not affecting the other cleaned pipe or pipe to be coated. When compressed air cleaning facilities are not available, vacuum cleaning or other suitable methods may be used.	



Sr. No	Description	Compliance by 3LPE coating mill										
7.1.19	<p>Improperly cleaned pipe shall be re-cleaned at the expense of the Supplier. The cleaned pipe shall be immediately transferred to the coating racks. The pipe surface shall not be allowed to flash rust before coating. Under no circumstances shall the total elapsed time from the start of cleaning to the application of coating exceed the following time humidity table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;"><u>Relative humidity (%)</u></th> <th style="text-align: center;"><u>Time (hours)</u></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">80</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">70</td> <td style="text-align: center;">1.5</td> </tr> <tr> <td style="text-align: center;">60</td> <td style="text-align: center;">1.75</td> </tr> <tr> <td style="text-align: center;">50</td> <td style="text-align: center;">2.0</td> </tr> </tbody> </table>	<u>Relative humidity (%)</u>	<u>Time (hours)</u>	80	1	70	1.5	60	1.75	50	2.0	
<u>Relative humidity (%)</u>	<u>Time (hours)</u>											
80	1											
70	1.5											
60	1.75											
50	2.0											
7.1.20	No blast cleaning should be performed in relative humidity greater than 80% unless the pipe is heated 3°C above the dew point formation temperature or 25°C, whichever is higher.											
7.1.21	Any raised silver, scabs, laminations or bristles of steel remaining on the newly cleaned pipe surface shall be removed using abrasive sanders. This operation shall not burnish or destroy the surface anchor pattern.											
7.1.22	Any surface preparation which does not conform to these specifications (just prior to coating) shall be rejected. Grease-free chalk shall be used to mark areas, which do not meet the specified requirements.											
7.1.23	It is very important that the specified surface cleanliness exists at the point of coating application. The period between cleaning and coating shall be kept to a minimum.											
<b>7.2</b>	<b><u>Fusion Bonded Epoxy (FBE)</u></b>											
7.2.1	The coating manufacturer's specification for the application and curing temperature and time of the specified Fusion Bonded Epoxy Powder System shall become a part of this Specification. It is the intention of this provision that the Supplier will be required to make applications of the coating materials in accordance with the coating manufacturer's recommendations, and to work with the coating manufacturer and/or the coating manufacturer's representative to eliminate any difficulties that might arise in the application of the FBE coating. The use of a liquid applied epoxy coating in lieu of the FBE is not permitted.											
7.2.2	The FBE coating shall be applied by electrostatic spray to produce a uniform coating with minimum dry film thickness (DFT) of 300 microns.											
7.2.3	The maximum allowable thickness on any pipe is 400 microns. Thickness in excess of 400 microns will be dis-positioned by the coating mill.											
7.2.4	The pipe shall be uniformly preheated to between the minimum and maximum temperatures recommended by the powder manufacturer for optimum application conditions.											
7.2.5	Temperature of each pipe shall be checked continuously by accurately calibrated indicating and recording pyrometers approved by the COMPANY/ENGINEERING CONSULTANT. When used these shall be checked for error not less than every four hours against calibrated temperature measuring instruments.											



## Specification for Three Layer Polyethylene Coating

Sr. No	Description	Compliance by 3LPE coating mill
7.2.6	Oxidation of the steel prior to coating in the form of 'bluing' or other apparent oxide formation is not acceptable. If such oxidation should occur, the pipe shall be cooled to ambient temperature and re-cleaned.	
7.2.7	Prior to coating with fusion bonded epoxy powder, the powder application system shall be thoroughly cleaned to remove any powder other than that in use.	
7.2.8	The use of recycled powder shall not be permitted	
7.2.9	<b>Adhesive</b>	
7.2.9.1	The Supplier shall ensure that rollers push the adhesive into the base of welds to eliminate presence of any air entrapment or voids immediately adjacent to the longitudinal weld. The adhesive layer shall be applied before the FBE gel time has expired by using either the crosshead or lateral extrusion technique. Application of the adhesive shall not be permitted after full curing of the FBE. The Supplier shall establish to the satisfaction of COMPANY/ENGINEERING CONSULTANT that adhesive is applied within the gel time window of the FBE and at the temperature recommended by the adhesive manufacturer. The Supplier shall state the proposed time interval (minimum and maximum) between FBE and adhesive applications at the proposed pipe temperature range and extent of overlap.	
7.2.9.2	The adhesive shall be applied to a thickness of between 300 and 400 microns as approved by the COMPANY/ENGINEERING CONSULTANT.	
7.2.10	The coating close to pipe end shall be cut back for the length of 150 mm. The end of the coating shall be beveled at 30 degrees. Any change in the cut back must be approved by the Company.	
7.2.11	'Frothing' of the coating at the steel/coating interface shall be avoided.	
7.2.12	All compressed air used for delivery of FBE in the coating chamber shall be free from moisture, oil and other contaminants.	
7.2.13	Immediately after application of FBE layers, copolymer adhesive and HDPE will be coextruded within the gel time of the FBE as per manufacturer's requirement.	
7.3	<b>Polyethylene Backing</b>	
7.3.1	The Polyethylene shall be applied by either the cross-head or annular extrusion technique by a procedure approved by the Company/Engineering Consultant. The polyethylene shall be applied over the adhesive within the time limits established during pre-production testing. The polyethylene outer layer shall enclose FBE and intermediate copolymer adhesive and provide a waterproof barrier capable of withstanding external hydrostatic pressure to water depths of up to 20m.	
7.3.2	The polyethylene topcoat shall have a minimum thickness of 3000 (for 30" and above) microns and shall be able to withstand impact without deterioration of polyethylene coating during backfilling of the trench after installation. Manufacturer may propose a different thickness of the outer jacket to suit the application; however, it shall be subject to approval of the Company.	
7.3.3	Care shall be taken not to damage the FBE corrosion protection coating when preparing cutbacks.	

Sr. No	Description	Compliance by Line Pipe Manufacturer
8.0	<b><u>INSPECTION</u></b>	
	In addition to the tests required on the material batches. Manufacturer shall perform the tests detailed below on finished coatings to demonstrate compliance with this specification.	
8.1.1	<u>Coating Procedure Qualification Testing</u>	
8.1.1.1	Prior to commencing full production, two pipes shall be coated of each pipe diameter with single layer FBE and eight pipes of each pipe diameter shall be coated with full coating system in accordance with the coating procedure specifications witnessed by the Supplier for Qualification Testing. Supplier shall cut samples from each pipe, which are adequately sized to permit the required testing.	
8.1.1.2	The two FBE coated pipes shall be subjected to complete set of tests as specified in Table-1.	
8.1.1.3	Supplier shall select samples from four full-system coated pipes. These samples shall be inspected and tested as per requirements detailed in Table 1.	
8.1.1.4	Pipes selected for PQT testing shall pass all the criteria contained in Table 1 before production commences.	
8.1.2	<u>Production Testing</u>	
	If problems develop, or significant changes occur, i.e. in materials (FBE, Adhesive, PE batches) or in production parameters, these tests should be run on the first production.	
	Production testing shall be performed at the frequency shown in Table 2.	
	The frequency shown in Table 2 will be for normal production.	
	One sample of coated pipe shall be sent to the company for storage. This sample shall be taken from the same piece of pipe as the Cathodic Disbondment (CD) test samples and should be 1 m long and at least half the circumference of the pipe	
8.1.3	<u>Visual Inspection</u>	
8.1.3.1	The following external surfaces of the coated pipe shall be carefully inspected: <ul style="list-style-type: none"> <li>• Adjacent to the cut back at each end of pipe.</li> <li>• Adjacent to longitudinal welds</li> <li>• Within the thickness of the coating.</li> </ul>	
8.1.3.2	The coating shall be smooth, and shall be blemish free, with no dust or other particulate inclusions. The coating shall not show any defects such as wrinkles, engravings, deep cuts, swelling, unbonded zones, air inclusion tears, voids, etc.	
8.1.4	<u>Coating Thickness</u>	
8.1.4.1	The thickness of the cooled Three Layer coating system shall be checked using an approved magnetic or electromagnetic type gauge.	
8.1.4.2	Measurements shall be made on at least 12 points uniformly spaced over the length of pipe and its circumference. At least 3 points shall be on the welds.	
8.1.4.3	The maximum coating system thickness shall be 3.0 mm.	
8.1.4.4	Any individual reading less than 3 mm shall be cause for the coated pipe length to be rejected. Such pipe may be held for further inspection and possible acceptance by the Supplier.	

Sr. No	Description	Compliance by 3LPE coating mill
9.0	<b><u>TESTING</u></b>	
9.1	<b><u>Holiday Detection</u></b>	
	Each pipe shall be inspected for holidays over 100% of its coated surface using high voltage DC detector. Holiday detection shall be performed on surfaces that are at ambient temperature and free from moisture or conductive surface contamination.	
	The detector shall be subject to Company/Engineering Consultant approval and a type that maintains intimate contact with the coating. The operating voltage between electrode and pipe shall be checked at least twice per working shift. The holiday test shall be performed in accordance with NACE RP-0274 standard.	
	The Supplier shall demonstrate to the Company/Engineering Consultant that setting of the detector is satisfactory for detecting pinholes. This setting will be checked once every two hours. The correct travel speed shall be determined by consistent detection of an artificial pinhole made in a good coating sample but shall not exceed 300 mm/s.	
	All holidays and other defects shall be marked for subsequent repair and re-testing. On re-testing, no holidays shall be permitted in the final coating.	
	The number of holidays for each pipe length shall be recorded. Coated pipe having holidays in excess of 1 per 2 square meters shall be stripped to bare metal and re-coated at no additional cost to the Company/Engineering Consultant.	
9.2	<b><u>Penetration Test</u></b>	
9.2.1	Penetration shall not be more than 0.2 mm for a test conducted at 25 ° C and 0.3 mm at 50 ° C for extruded coatings as per DIN 30670.	
9.2.2	The test shall be conducted on five (5) twist specimens taken from different pipes. If one of the specimens proves to be not satisfactory, ten (*10) other specimens shall be re-tested and give satisfactory results.	
9.2.3	<p><u>Test Procedure</u></p> <ul style="list-style-type: none"> <li>• Take a test specimen of the pipe coating.</li> <li>• Immerse the test specimen in the water bath at the test temperature and leave it for at least 1 hour.</li> <li>• Place the penetrator and read the measure on the 1/100 comparator (1).</li> <li>• Load the inertia block onto the penetration in one go (1 kg/mm<sup>2</sup> penetrator cross-section).</li> <li>• Read the comparator (2).</li> <li>• The difference (2-1) gives the penetration depth at 1/100 mm.</li> </ul>	
9.3	<b><u>Impact Resistance Test</u></b>	
	A sample of coated pipe shall be impact tested in accordance with the procedure specified in DIN 30670.	
	Tests shall be performed at temperature of 23± 2°C.	
	When tested in accordance with sub clause 5.3.4. DIN 30670, the coating shall withstand 30 impacts without any electrical breakdown occurring.	
9.4	<b><u>Transverse Electric Resistivity Test</u></b>	
	The test consists of measuring at regular intervals the insulation strength of the coating of a pipe immersed in a salt solution.	
	A sleeve of the coated pipe shall be used and obturated at one end to prevent the salt solution from coming into contact with the metal when the sleeve is immersed.	
	At regular intervals, the transverse resistivity shall be measured with the megohmmeter. The transverse resistivity of coating, Rs, is expressed by the formula: Rs = R.S. In which, R: Electric resistance and S : immersed pipe surface area in m <sup>2</sup>	
	The transverse resistivity of coating after 100 days of immersion shall be at least 10 <sup>8</sup> m <sup>2</sup> .	

Sr. No	Description	Compliance by 3LPE coating mill
<b>9.5</b>	<b><u>Resistance to Ultraviolet</u></b>	
9.5.1	The test is carried out with a radiation apparatus equipped with a xenon lamp. The elongation at break of the sample after the tension test is compared with that of an identical non tested sample.	
9.5.2	The test specimens are exposed to the xenotest radiation for 800 hours at a temperature of 60 ° C and in relative air humidity of 65%.	
9.5.3	The percent elongation rate is measured on five (5) test samples after radiation at a tension speed of 50 mm/min. The same operation is performed on 5 non-exposed samples. The tension speed is the same.	
9.5.4	The mean elongation rate after exposure to xenotest shall be at least equal to 50% of the mean elongation rate before exposure to radiation.	
<b>9.6</b>	<b><u>Cathodic Disbondment Test</u></b>	
9.6.1	Cathodic disbondment testing shall be performed for 30 days in a 3% NaCl electrolyte at 23± 2°C with potential of 1.5 V in accordance with ASTM G42. The acceptance criteria shall be 5 mm maximum disbondment from the edge of the pre-drilled hole.	
9.6.2	<b><u>Degree of Cure</u></b>	
9.6.2.1	A thermal analysis shall be carried out using a Differential Scanning Calorimeter (DSC).	
9.6.2.2	Epoxy film samples shall be removed from the coated pipe using hammer and cold chisel. This produces furled coating flakes. Care shall be taken to remove samples of full film thickness, but at the same time avoid the inclusion of steel debris and contamination with adhesive or polyethylene. The sample shall be tested for cure using DSC procedure.	
9.6.2.3	The glass transition temperature differential (Tg) shall be the test used to verify cure along with a visual examination to ensure no residual cure in the portion of the graph beyond the glass transition.	
9.6.2.4	The required cure characteristics are: $\Delta T_g = 2^\circ\text{C to } +3^\circ\text{C}$ ( $\Delta T_g = \Delta T_g \text{ final} - \Delta T_g \text{ initial}$ ) Only a 95% minimum cured coating shall be acceptable. $\% \text{ Cure} = (\Delta H - \Delta H \text{ residual}) \times 100 / \Delta H$ ( $\Delta H = \text{exothermic heat of reaction}$ )	
<b>9.6.2</b>	<b><u>Flexibility Test</u></b>	
9.6.2.1	The flexibility of the coating shall be determined once on the first day of production using only FBE layer coated pipes (2 Nos.) by the following method:	
9.6.2.2	Coated samples (300 mm x 50 mm x thickness of pipe wall) taken from an FBE coated pipe joint shall be subjected to a bend test at a temperature of 0°C and 20°C to induce a 2% and 3% strain respectively in the sample.	
9.6.2.3	At each temperature the test shall be carried out in twofold. The deflection loading rate during bend testing shall be 25±2 mm/min.	
9.6.2.4	The mandrel sizes shall be selected according to the following formula: $D = \frac{t(1-S)}{S}$ Where : D = Mandrel diameter (mm) t = Specimen wall thickness (mm) S = 0.02 at 0°C 0.03 at 20°C	
9.6.2.5	The coating shall not exhibit any signs of cracking, disbondment or pinholes.	

## Specification for Three Layer Polyethylene Coating

Sr. No	Description	Compliance by 3LPE coating mill
9.6.3	<b><u>Hot Water Resistance Test</u></b>	
9.6.3.1	Hot water resistance test as detailed below shall be carried out on two pipes coated with only FBE layer.	
9.6.3.2	A coated sample of 200 mm x 100 mm machined from a pipe ring of the coated pipe shall be immersed in potable water at 85°C for 5 hours.	
9.6.3.3	The bare edges of the sample shall be coated with a surface tolerant epoxy or epoxy phenolic to prevent ingress of moisture beneath the coating.	
9.6.3.4	Immediately after the 5 hours exposure, the coated sample shall be removed from the water bath and allowed to cool to ambient temperature. Subsequently, the coating adhesion shall be tested by the following method:	
9.6.3.5	Using a sharp and pointed knife, two incisions of approximately 15 mm in length shall be made through to the steel surface to form an "X" with an angle of intersection of approximately 30°. Commencing at the intersection, an attempt shall be made to lift the coating from the steel substrate, using the blade of the knife.	
9.6.3.6	Resistance of the coating to peel or a cohesive failure entirely within the coating in the absence of excessive voids caused by foaming constitutes a pass. Partial or complete adhesion failure between the coating and the metal substrate constitutes a failure.	
9.6.3.7	Cohesive failure caused by voids in the coating, leaving a honeycomb structure on the steel surface, also constitutes a fail condition.	
9.6.3.8	In addition, the coating shall not show any tendency towards disbonding or blistering. A slight discoloration of the coating is acceptable.	
9.6.3.9	If holidays occur on successive pipes, the Supplier shall stop the coating line immediately to determine the cause and take corrective action.	
9.6.4	<b><u>Adhesion And Peel Tests</u></b>	
9.6.4.1	The adhesion strength of the FBE shall be determined in accordance with ASTM D4541. The minimum adhesion strength shall be 21 kg/cm <sup>2</sup> .	
9.6.4.2	The three layer coating system peel strength shall be determined in accordance with the methods described in DIN 30670. The test shall be performed at 20± 5°C and 50± 5°C. Tests shall be carried out on pipe body as well as on the weld.	
9.6.4.3	Minimum peel strength shall be at least 35 newtons per centimeter width of strip peeled at 20+ 5°C and 15 newtons per centimeter with at 50+ 5°C in accordance with paragraphs 4.2.3. and 5.3.3. of DIN 30670.	
9.6.4.4	The failure mode shall be recorded. The failure should occur as a cohesive failure within the Three Layer System or at the adhesive/PE interface or adhesive/FBE interface. If failure occurs at the FBE/steel interfaces, this will be considered a total failure of the system.	



**TABLE - 1**

**SUMMARY OF INSPECTION AND TESTS TO BE CARRIED-OUT FOR  
 PROCEDURE QUALIFICATION OF  
 LINEPIPE COATING FOR EACH PIPE DIAMETER**

<b><u>Property</u></b>	<b><u>Acceptable Values</u></b>	<b><u>Number of Tests</u></b>
<b><u>Before Cleaning</u></b>		
◆ Pipe condition	Condition A&B of ISO 5801 (part 1)	10
◆ Chlorides	2 μ g cm <sup>2</sup>	30 (3x10 pipe)
◆ Oil Contamination	No indication of oil contamination	10
<b><u>After cleaning</u></b>		
◆ Cleanliness	Sa 2 ½	10
◆ Profile	50 – 100 μm	10
◆ Chloride	2μ grams/cm <sup>2</sup>	30(3x10 pipe)
◆ Dust and Oil	No indications of dust or oil contamination.	
<b><u>Coating Thickness</u></b>		
◆ FBE coated	300μm - 400μm	24(12x2 pipes)
◆ FBE+Adhesive+PE	3050μm for Pipe DN < 500 mm 3550μm for Pipe DN > 500 mm	120(12x10 pipe)
<b><u>Property</u></b>	<b><u>Acceptable Values</u></b>	<b><u>Number of Tests</u></b>
<b><u>Holidays</u></b>		
◆ FBE	Smooth with no surface defects	2
◆ FBE+Adhesive+PE	Smooth with no surface defects	10
<b><u>Adhesion/Peel Strength</u></b>		
◆ FBE	Resistance to peel or a cohesive failure	2
◆ FBE+Adhesive+PE	35N/cm at 20± 50°C, 50N/cm at 50+2°C	10 (2x5 pipes)
<b><u>Impact resistance</u></b>		
◆ FBE	18J (minimum)	2
◆ FBE+Adhesive+PE	Zone A of Fig. 1 DIN 30670	5 (Random)
<b><u>Penetration (indentation) testing</u></b>		
◆ FBE	0.20mm at 25°C, 0.30 mm at 50°C	10(2x5 pipes)
◆ FBE+Adhesive+PE	Original Value	2
<b><u>Degree of Cure</u></b>		
◆ FBE	-2°C ≤ ΔTg ≤ +3°C	2
◆ FBE+Adhesive+PE		3 (Random)



**Flexibility Bend Test**

◆ FBE No cracking/disbondment pinholes 2

**Hot water resistance**

◆ FBE No disbanding or blistering after adhesion 1 (Random) tests.

**Cathodic disbondment**

FBE Average radius of disbondment 5 mm 2

FBE+Adhesive+PE Average radius of disbondment 5 mm 3 (Random)

**Transverse electric resistivity test**

Resistance of  
Ultraviolet.

10<sup>8</sup>m<sup>2</sup> after 100 days of immersion.

800h at 60°C in 65% relative humidity  
50%



**TABLE 2**

**SUMMARY OF INSPECTIONS AND TESTS TO BE CARRIED-OUT**  
**FOR PRODUCTION OF**  
**COATING OF LINEPIPE SYSTEM FOR EACH PIPE DIAMETER**

<u>Property</u>	<u>Acceptable Values</u>	<u>Minimum frequency</u>
<b><u>Before Cleaning</u></b>		
◆ Pipe condition	Conditions A&B of ISO 8501 (part 1)	
◆ Chlorides	2 $\mu$ g cm <sup>2</sup>	
◆ Oil	No indication of oil contamination	
<b><u>After cleaning</u></b>		
◆ Cleanliness	ISO-Sa 2 ½	
◆ Profile	50 – 100 $\mu$ m	
◆ Chloride	<2 $\mu$ g /cm <sup>2</sup>	
◆ Dust	No indications of dust contamination.	
◆ Oil	No indications of oil contamination.	
<b><u>FBE Application</u></b>		
◆ Pipe temperature	MANUFACTURER'S required range	Continuous
Coating Thickness	300-400 microns	Each pipe
Holidays	No holidays.	Each pipe
<b><u>Visual Examination.</u></b>		
◆ Thickness of coating	No surface defects	Each pipe
◆ Longitudinal welds.	No air conrapment.	
◆ Cut backs	150+0/-20 mm width, bevel 45°	
<b><u>Peel Strength</u></b>		
◆ At 20°C	35 Newtons per cm width of strip peeled	1 per 100 pipe
◆ At 50°C	15 Newtons per cm width of strip peeled	1 per 100 pipe
	Zone A of Fig. 1 DIN 30670	1 per 100 pipe
<b><u>Impact Resistance</u></b>		
<b><u>Penetration</u></b>	MANUFACTURER'S required range	1 per 100 pipe
<b><u>(indentation) Testing</u></b>		
<b><u>Cathodic Disbondment</u></b>	< 5 mm	First pipe, last pipe and at intervals of every 350 pipes.
<b><u>Hot Water Resistance</u></b>	No disbonding or blistering after adhesion tests.	First pipe, last pipe and at intervals of every 350 pipes.

#### **4.0 COATING REPAIRS**

##### **10.1 General**

10.1.1 The Coating mill shall submit a repair procedure for the approval of the Company prior to the start of production.

10.1.2 The Supplier shall demonstrate that the repair is as strong as the parent material.

##### **10.2 Repair of Bare Pipe**

10.2.1 Scratches, grooves, gouges, and slivers may be removed by filing or grinding, in accordance with procedures approved by the Company.

10.2.2 The Supplier shall grind or otherwise repair damaged bevels and pipe found to have been damaged, in accordance with the pipe repair section of the Line Pipe Spec. 4985-PA-2006.

10.2.3 All ends of pipes which are damaged to such an extent that they cannot be repaired by grinding or filing shall be rebevelled by the Supplier.

10.2.4 The Supplier shall furnish a bevelling machine for repair of the pipe ends.

##### **10.3 Repair of Polyethylene Coating**

Damaged line coating shall be repaired as per the following criteria:

a. Small Damages Extending up to 1.0 cm<sup>2</sup>

Small damages to 3LPE should be repaired using PE melt sticks; with epoxy primer if bare metal is visible.

b. Damages Extending up to 300 mm or 100 cm<sup>2</sup>

Polyethylene repair patches precoated with hotmelt adhesive, should be used in conjunction with a hotmelt filler adhesive and epoxy primer (if bare steel visible) as per manufacturer's recommendations. Repair patches when installed should overlap the damaged area by minimum 50 mm all round. Surface shall be mechanically cleaned before the application of FBE primer.

c. Damages Extending Over 300mm or 100cm<sup>2</sup>

Full encirclement heatshrink sleeves with epoxy primer in accordance with specification. Surface shall be mechanically cleaned before the application of FBE primer.

The Supplier shall warrant that if the coating is found defective or not meeting the required performance the Supplier shall repair or replace the defective coating. The warranty shall be valid for 12 months from the acceptance date of pipeline facility.



**5.0 IDENTIFICATION & MARKING**

- 11.1 The pipe will be delivered to the Supplier marked in accordance with the Spec. 4880-PA-2006. The Supplier shall maintain the pipe identification throughout the process of cleaning and coating of the pipe.
- 11.2 Additional markings shall be applied 50 mm from the end of the coating and outside the pipe at each end. Letters and numerals shall be 25 mm in height.
- 11.3 Pipe which has undergone repair in accordance with section 10.0 shall be marked with a band painted around the entire circumference of the coated pipe and not more than 75mm from the cutback at each end. These pipe sections will be retained as spares by the Company.
- 11.4 All markings shall be stenciled and spray applied with paint compatible with the coating material and of a contrasting color.
- 11.5 Pipes of different wall thickness shall be color coded with different color bands.



**6.0 STORAGE HANDLING & SHIPPING**

- 12.1 The coated pipe shall at all times be handled in a manner to avoid damage to the coating.
- 12.2 The coated pipe shall be supported only by the uncoated ends until the coating has cooled to ambient temperature.
- 12.3 The coated pipe shall be stored in an area, which will not result in accumulation of dust or dirt either from the environment or surrounding.
- 12.4 The coated pipe shall be protected to avoid degradation from ultraviolet light radiation.
- 12.5 Any coated pipe section that shows contamination in any form whatsoever from the environment or surrounding shall be adequate grounds for stripping the entire coating and completely re-coating the pipe with 3-layer polyethylene and/or FBE as considered appropriate by Company's/Engineering consultant representative.
- 12.6 All pipes which have undergone repair shall be stockpiled separately from non-repaired joints or shall be color coded for ease of identification.
- 12.7 A padding approved by the Company shall be provided between the pipe stacked after coating during storage, transportation and shipment.
- 12.8 The number of rows of pipes to be stacked up shall not exceed six.



**7.0 DOCUMENT SUBMITTALS**

13.1 The Supplier shall submit copies of each of the following documents to the Company/Engineering Consultant as set forth below:

<b>Document</b>	<b>Submittal</b>	<b>No of Copies</b>
Quality Control and Application Procedures	Before PQT	2
Coating Repair Procedures	Before PQT	2
Storage, Handling and Transportation Procedures	Prior to Coating	2
Qualification Test Report	Prior to Coating	2
Certified Material Test Certificates	Prior to Coating	2
Certified Inspection Report	Weekly	1
Tally Record of Pipe Received	Weekly	1
Tally Record of Pipe Coated/Loaded Out	Prior to Shipping	6
Coating Repairs Undertaken	Reported Daily	1

13.1 All certificates shall be in English language and with SI units of measure. Certificates shall be visibly signed by the Supplier.

13.2 The Supplier shall maintain a complete record of the pipe from the time it first enters the coating yard until the completion of load out of coated pipe. Pipe joint length and date of the coating application shall be recorded for each joint of pipe. The Supplier shall provide this information to the Company according to the schedule specified above.



**8.0 TRANSPORTATION**

The Supplier shall be responsible for the good condition of the coated pipes. In all cases, the Supplier shall be responsible for the repair of coated pipes until the pipeline is taken over by the Company/Engineering Consultant. On receipt of coated pipes, at Site, the Company/Engineering Consultant shall be invited for the inspection of coating. The Supplier shall arrange for the re-coating or replacement of pipes found to be excessively damaged.

A handwritten signature in black ink, consisting of a stylized, cursive letter 'A' with a long, sweeping tail that extends to the right and then loops back down.



**9.0** **WARRANTY**

The Supplier shall warrant that if the coating is found defective or not meeting the required performance the Supplier shall repair or replace the defective coating. The warrantee shall be valid for 24 months from the acceptance date of the pipeline facility.

A handwritten signature in black ink, consisting of several overlapping loops and a long, sweeping tail that extends upwards and to the right.