



# GOLAGHAT-BCPL LAKWA PIPELINE PROJECT

## MATERIAL REQUISITION FOR LINE PIPE

Doc No: P101-MRR-P001

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B	08.03.2022	Issued with Tender	PNS	MD	AD
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## ABBREVIATIONS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
ASTM	American Society of Testing and Material
CS	Carbon steel



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**1.0 BACKGROUND**

Assam Gas Company Ltd. (AGCL) is a 60 years old Natural Gas transmission and distribution company, wholly owned by the Govt. of Assam with its registered office at Duliajan, Dist: Dibrugarh, Assam 786602.

The company transports Natural Gas through its integrated pipeline infrastructure to several market segments i.e. Power, Fertilizer, Petrochemicals, Industrial, Commercial and Domestic consumers primarily located in upper Assam. The present infrastructure of the company has a transportation capacity of about 6.0 MMSCM of gas per day.

Besides other sources, AGCL is going to transport Natural Gas from the gas fields of ONGCL in Khoraghat region of Golaghat District through its 12" & 8" NB 97 km Khoraghat/ Nambor Uriumghat – Golaghat gas pipeline(N-G-N).

Company is expecting additional transportation of around 130,000 SCMD of Natural gas from the above-mentioned Pipeline. AGCL is planning to supply this additional gas to Brahmaputra Cracker and Polymer Limited (BCPL) through Proposed Golaghat - BCPL Lakwa Pipeline.

Pipeline Engineering Consultants Pvt. Ltd. has been appointed as Engineering Consultant by AGCL for Consultancy services (Engineering, Procurement, RFP preparation and Project Management for the Project.

**2.0 PURPOSE**

This document is for the design, manufacturing and purchase of line pipe for Construction of Cross-Country Natural Gas Pipelines in Golaghat BCPL Lakwa Districts of Assam.

**3.0 DEFINITION**

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order.

PROJECT	GOLAGHAT-BCPL LAKWA PIPELINE PROJECT
CLIENT/ OWNER	Assam Gas Company Limited
EPMC	Pipeline Engineering Consultants Pvt. Ltd. (PLECO) the party to act for and on behalf of OWNER for the Detailed Engineering Services and Project Management.
CONTRACTOR	Agency appointed by CLIENT/ OWNER for execution of assigned tasks
PURCHASER	Either of CLIENT, OWNER or EPMC
VENDOR/ MANUFACTURER	Party, which manufactures and supplies equipment and services to the OWNER or to CONTRACTOR

#### 4.0 PROJECT BRIEF

The brief project details of Golaghat to BCPL, Lakwa pipeline are as follows:

AGCL wants to extend its existing N-G-N pipeline network from Golaghat to BCPL Lakwa Terminal. This project foresees transportation of 1, 30,000 SCMD Gas to BCPL via 12" OD cross-country pipeline. The project broadly consists of:

- Laying of 12" x 122 KM (approx.) Carbon Steel Pipeline from Golaghat Station to BCPL plant
- Laying of 12" x 2 KM (approx.) Carbon Steel Pipeline from BCPL plant to AGCL Lakwa station

The preliminary proposed facilities for the pipeline are:

- i. Dispatch station at Golaghat
- ii. Sectionalizing Valve(SV) stations,
- iii. Receiving Terminal at BCPL plant
- iv. Tap off point at AGCL "O" Point

#### 5.0 DOCUMENT PRECEDENCE

It shall be the responsibility of the MANUFACTURER/ VENDOR to inform the PURCHASER of any errors, ambiguities, inconsistencies, discrepancies or conflict of information that may be found to exist in any document, specification or drawing submitted by the PURCHASER.

In case of conflict, the order of precedence shall be as follows:

- a) MR
- b) Basic Documents (Specifications)
- c) Codes and Standards

As a general rule in the event of any discrepancy between technical matter and local laws/ regulations (and documents above listed) the most stringent shall be applied.

MANUFACTURER/ VENDOR shall notify PURCHASER of any apparent conflicts between MR, specifications, related datasheets, any code and standards and any other specifications noted herein. (Resolution and/ or interpretation precedence shall be obtained from PURCHASER in writing before proceeding with the design/ manufacturer or completion of services.)

#### 6.0 SCOPE OF SUPPLY

Sl. No.	DESCRIPTION	QTY	REMARKS
1.1	Pipes	As per Bill of Material Clause 7.0 of this document	
1.2	Painting and Coating	1 LOT	As per specification
1.3	Inspection and Testing	1 LOT	As per specification

Sl. No.	DESCRIPTION	QTY	REMARKS
1.4	Inspection and Test Plan	1 LOT	To be submitted by vendor
1.5	Certification accordance with EN10204, 3.2 certificates.	1 LOT	As per specification
1.6	Vendor Documentation	1 LOT	As per specification
1.7	Marking, Packaging & Transportation	1 LOT	As per specification
1.8	Preparation for Shipment	1 LOT	As per specification
1.9	Delivery Point	Golaghat, Mariani and Amguri	
1.10	Delivery Schedule	As defined in the Tender	

## 7.0 BILL OF MATERIAL

Manufacturing, Inspection, testing and supply of line pipe as per specifications P-SPC-002 including 3LPE coating as per specification P-SPC-003, packing, transportations, handling delivery of coated & Bare pipe as per tender conditions, including supply of documentation/ drawings as per the enclosed specifications, and other codes and standards enclosed or referred.

ITEM NO	SIZE (INCH)	THK. (MM)	MATERIAL (PSL-2)	EXTERNAL COATING	METHOD OF MANUFACTURE	QTY (Mtr)
<b>COATED LINE PIPE</b>						
1.	12"	6.4	API 5L GR.X-42	3 LPE	HFV	22902
2.	12"	7.1	API 5L GR.X-42	3 LPE	HFV	102109
<b>BARE LINE PIPE</b>						
3.	12"	7.1	API 5L GR.X-42	-	HFV	868

## 8.0 DESIGN DATA

Description	Value
Product	Natural Gas
Design Pressure (Maximum)	49 Kg/cm <sup>2</sup>
Material Specification	API 5L GR X-42
Corrosion Allowances	0.5 mm
Corrosion Protection	3 layer PE coated and Cathodic Protection

### NOTES:

1. All bare pipes are meant for hot induction bend & station piping and shall have zero negative wall thickness tolerance.
2. Negative tolerance for coated pipe wall thickness is not acceptable.
3. Overall length tolerance shall be (-) Zero and (+) One pipe length to complete the ordered quantity.
4. Pipe Manufacturer shall furnish valid license to use API monogram on API 5L Line pipes – Product Specification Level 2 (PSL-2) quality for the proposed pipe mill(s) along with the offer. The submitted API license shall be valid throughout the manufacturing period till completion of order.
5. Steel shall be procured from approved steel mill only.
6. Charpy impact test shall be carried out at (-) 29 degree Celsius.
7. Quantity may vary  $\pm 10\%$  for coated pipe &  $\pm 25\%$  for bare pipe. Final quantity will be informed to successful bidder.
8. Bidder also to consider a provision for manufacturing of extra pipe (If required by Client) after placement of order & during execution / laying of pipeline on site. Extra line pipe length may vary from 10% to 15% and the required pipe may be coated or bare pipe or both.
9. Hydrotest shall be carried out 95% of SMYS.
10. Pipes shall be supplied between 11.5 m to 12.5 m in length as specified in specification.
11. Delivery of the pipe shall be as following:

DELIVERY LOCATION FOR COATED PIPE				
S.NO.	PIPE SIZE (INCH)	GOLAGHAT	MARIANI	AMGURI
1.	12" X 6.4 MM	2100	13050	7752
2.	12" X 7.1 MM	27000	36498	38611



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DELIVERY LOCATION FOR BARE PIPE				
3.	12" X 7.1 MM	868	0	0

12. Supply of all coating materials as per specification no. P-SPC-003 for carrying out 3-layer polyethylene coating.
13. All works associated with the supply of bare/ coated line pipes and maintenances of dump yard are detailed in "Scope of Work for procurement of bare/ coating line pipe".
14. Handling, loading, transportation of pipes from manufacturer plant is in bidder scope. Owner shall arrange for adequate land for Storage Yards.
15. Bidder shall make his own arrangement of labor and crane, permits etc. for unloading, Stacking /Storing of bare & coated pipes to designated storage yards, any material requirement for stacking, all necessary arrangement till handing over to Owner shall be in bidder scope.
16. Bidder shall inspect of all bare & coated line pipes in presence of Owner representative while handing over of pipes. Also Bidder shall carry out 10% of pipes for Holiday inspection while handing over of pipes. Repair of damaged pipes, beveled end defects and damaged coating (including supply of coating materials for repair) noticed at the time of handing over of bare/ coated pipes. All handling, lifting tools etc. required for inspection of coated/ bare line pipes at Storage Yards shall be carried out by the bidder.
17. Also Bidder shall carry out 10% pipe Internal Diameter inspection by Pull through (95% of ID) shall be carried out by bidder during handling over pipes to owner.
18. For butt weld end, bevel shall be in accordance with API specification 5L or ASME B16.25 as applicable.
19. Bevel Protector or end caps shall be installed on all pipe ends. End caps shall be hook able type which shall allow the use of end hooks without the need for their removal during pipe handling. The bevel protector shall be the re-usable type. The details of the bevel protector/end caps shall be furnished for approval prior to start of the production.
20. All major damage to pipe ends/ bevels, including dents or gauges, shall be repaired by removal of damaged pipe material and re-beveling. No welding on the pipe surface shall be allowed. During inspection at storage yard, if owner get a defective pipe & the pipe is unacceptable to owner, then that pipe shall be replaced by supplier without any extra cost.
21. Inspection of Field Test and Warranty.
22. Purchaser shall be reimbursed by Manufacturer for any pipe furnished on this order that fails under field hydrostatic test if such failure is caused by a material/ manufacturing defect in the pipe. The reimbursement cost shall include pipe, labor and equipment rental for finding, excavating, cutting out and installation of replaced pipe in position. The field hydrostatic test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 95 percent of specified minimum yield strength.





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23. In case Manufacturer so desires, he will be advised at least two weeks in advance so that his representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative.
24. Bidder shall furnish quotation only in case he can supply material strictly as per this MR and specification forming part of MR.
25. Indicative ITP for line pipe are enclosed with MR. Bidder to follow the same.
26. Bidder shall submit Forms for Check List, Reference list for Supply of line pipe, Compliance statement, Deviation Sheet, duly filled, signed and stamped along with the bid. Bidder to note that previous track record shall be filled up in Form of reference list only, with all details as required in attached format. Track records in the other formats are not acceptable.
27. If the offer contains any technical deviations or clarifications or stipulates any Technical specifications (even if in line with MR requirements) and does not include complete scope & technical/ performance data required to be submitted with the offer, the offer shall be liable for rejection.
28. The submission of prices by the Bidder shall be construed to mean that he has confirmed compliance with all technical specifications of the corresponding item(s).
29. Inspection and tests performed/witnessed by purchaser's inspector shall in no way relieve the manufacturer's obligation to perform the required inspection and test.
30. Bidder must submit all documents/ drawings/ calculations as specified in relevant specification along with his offer and after award of order.
31. Purchaser's inspector reserves the right to perform stage wise inspection and witness tests, as indicated in specification at manufacture's works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities require for inspection to the purchaser's inspector. Inspection and tests performed/witnessed by purchaser's inspector shall in no way relieve the manufacturer's obligation to perform the required inspection and test.
32. Delivery of pipes shall be at Consortium designated storage yard and shall be in the Bidder's scope.

### 9.0 DOCUMENTS & DATA REQUIREMENTS

The table hereunder specifies the quantities and the nature of the documents to be submitted by the Manufacturer to the PMC. The documents required at the inquiry stage and to be included in the bid are listed under column A.

The documents required after award of the AGREEMENT and subject to the written approval of the PMC are listed under column B.

The final and certified documents are listed under column C.

Any document, even when preliminary, shall be binding and therefore duly identified and signed by the Manufacturer. It shall bear the PMC Project reference, the Material Requisition number and the identification number.

The documents are fully part of the supply which shall be complete only if and when the documents complying fully with the material requisition requirements are received by the engineer.

Item	Documents and Data	A	B		C	
		Number of copies	Number of copies	Required date	Number of copies	Required date
1.	Drawing/data submittal list and schedule	3	4	1 week + monthly	4	2 weeks after approval
2.	Production, test and delivery schedule (per item)	3	4	1 week + monthly	4	2 weeks
3.	Progress report	--	4	Daily + weekly + monthly	--	--
4.	Catalogues / References	3	--	--	--	--
5.	Description of application and quality with technical data of 3LPE for external coating	3	4	3 weeks	4	2 weeks after approval + with final techn. File
6.	Code compliance certificate (Quality manual, ISO certificate, API License)	3	4	3 weeks	4	2 weeks after approval
7.	QA/QC program (First Day Production + Regular production separately)	3	4	2 weeks	4	2 weeks after approval
8.	Inspection and test procedures	3	4	3 weeks	3	2 weeks after approval + with final techn. file
9.	A description with calculation for handling, storage, transportation procedure during total manufacturing cycle and long storage procedure		4	4 weeks	--	--

## MATERIAL REQUISITION FOR LINE PIPE

Item	Documents and Data	A	B		C	
		Number of copies	Number of copies	Required date	Number of copies	Required date
10.	Duly filled & signed Technical Questionnaire & documents.	3	data	--	--	--
11.	List of fabrication and control operations (LOFC)	--	4	2 weeks	4	2 weeks after approval
12.	NDE reports & Procedure	--	4	When available	4	2 weeks after approval + with final techn. file
13.	Heat treatment reports (When available)	--	4	When available	4	2 weeks after approval + with final techn. file
14.	Hydrotest and air test report (When available)	--	4	When available	4	2 weeks after approval + with final techn. file
15.	Material certificate	--	4	1 week after test	4	With final techn. file
16.	List of Owner approved subcontractors with their scope	--	4	2 weeks	--	With final techn. file
17.	Copy of purchase orders to subcontractors	--	4	2 weeks	--	With final techn. file
18.	Copy of purchase order	--	--	--	--	With final techn. file
19.	Packing/shipping list w/weights and dimensions	--	4	4 weeks	4	2 weeks before shipping
20.	Final technical file	--	--	--	6	With shipping

**NOTES:-**

1. Durations in column B (Required date) are weeks after Purchase Order date. Durations in column C (Required date) are weeks after document approval.

Due date of each document may be proposed.

2. Latest submittal time for:

- Test procedure : 2 weeks before test
- Test report : 2 weeks after test

3. Final technical file shall be supplied in hard copy as indicated, and in electronic format (PDF Acrobat files) on two (2) CD-ROMs

**10.0 LIST OF ATTACHMENTS**

1. Scope of work for Procurement of bare/ coated line pipe.
2. Specification for High Frequency Welded Line Pipe Doc. No. P-SPC-002
3. Specification for 3 Layer Polyethylene Coating of Line Pipes Doc. No. P-SPC-003
4. ITP for HFW/ Electric welded pipes Doc. No. P-ITP-001
5. ITP for 3-layer PE coating of line pipes Doc. No. P-ITP-003
6. Checklist Doc. No. P-STD-001
7. Reference List Doc. No. P-STD-002
8. Compliance statement Doc. No. P-STD-003
9. Deviation sheet Doc. No. P-STD-004
10. Drawing & Documents Doc. No. P-STD-005
11. Instruction to Bidders Doc. No. P-STD-006
12. Vender drawing document schedule. Doc. No. P-STD-007
13. TPI List,
14. Standard Drawings



# GOLAGHAT-BCPL LAKWA PIPELINE PROJECT

## SCOPE OF WORK FOR LINE PIPE

Doc No: P101-SOW-P001

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# SCOPE OF WORK FOR LINE PIPE

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## 1.0 BACKGROUND

Assam Gas Company Ltd. (AGCL) is a 60 years old Natural Gas transmission and distribution company, wholly owned by the Govt. of Assam with its registered office at Duliajan, Dist: Dibrugarh, Assam 786602.

The company transports Natural Gas through its integrated pipeline infrastructure to several market segments i.e. Power, Fertilizer, Petrochemicals, Industrial, Commercial and Domestic consumers primarily located in upper Assam. The present infrastructure of the company has a transportation capacity of about 6.0 MMSCM of gas per day.

Besides other sources, AGCL is going to transport Natural Gas from the gas fields of ONGCL in Khoraghat region of Golaghat District through its 12" & 8" NB 97 km Khoraghat/ Nambor Uriumghat – Golaghat gas pipeline(N-G-N).

Company is expecting additional transportation of around 130,000 SCMD of Natural gas from the above-mentioned Pipeline. AGCL is planning to supply this additional gas to Brahmaputra Cracker and Polymer Limited (BCPL) through Proposed Golaghat - BCPL Lakwa Pipeline.

Pipeline Engineering Consultants Pvt. Ltd. has been appointed as Engineering Consultant by AGCL for Consultancy services (Engineering, Procurement, RFP preparation and Project Management for the Project.

## 2.0 DEFINITION

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## 3.0 PROJECT BRIEF

The brief project details of Golaghat to BCPL, Lakwa pipeline are as follows:

AGCL wants to extend its existing N-G-N pipeline network from Golaghat to BCPL Lakwa Terminal. This project foresees transportation of 1, 30,000 SCMD Gas to BCPL via 12" OD cross-country pipeline. The project broadly consists of:



- Laying of 12" x 122 KM (approx.) Carbon Steel Pipeline from Golaghat Station to BCPL plant
- Laying of 12" x 2 KM (approx.) Carbon Steel Pipeline from BCPL plant to AGCL Lakwa station

The preliminary proposed facilities for the pipeline are:

- i. Dispatch station at Golaghat
- ii. Sectionalizing Valve(SV) stations,
- iii. Receiving Terminal at BCPL plant
- iv. Tap off Terminal at AGCL "O" Point

## 4.0 SCOPE

The scope of works includes supply of coated and bare line pipe as per material requisition and includes the following:

A. Carrying out all works associated with manufacture and supply of line pipes as per specifications P-SPC-002, application of 3-layer side extruded polyethylene external corrosion protection coating as per specification no. P-SPC-003 as per details covered herein and transportation of bare and coated pipes to designated storage yards including arrangement & maintenance of Storage Yards till handling over to installation contractor.

B. Works for arrangement of Storage Yard

- Land for Storage Yards near to ROU will be made available by the owner.
- The description in the subsequent sections pertains to Coated and bare pipes and associated works. The requirements shall be as applicable to the respective bidders as per their offer.

## 5.0 DETAILS OF DELIVERY POINT

DELIVERY LOCATION FOR COATED PIPE				
S.NO.	PIPE SIZE (INCH)	GOLAGHAT	MARIANI	AMGURI
1.	12" X 6.4 MM	2100	13050	7752
2.	12" X 7.1 MM	27000	36498	38611
DELIVERY LOCATION FOR BARE PIPE				
3.	12" X 7.1 MM	868	0	0

**6.0 WORKS ASSOCIATED WITH COATING (EXTERNAL) OF LINE PIPES/ SUPPLY OF COATED LINE PIPES**

**6.1 The Bidder's scope of work for the work tendered shall generally include, but not limited to, the following:**

- I. The Bidder's scope of work for the work tendered shall generally include, but not limited to, the following:
- II. Making necessary arrangement in Bidder's existing coating yard for the work, as applicable.
- III. Supply of all coating materials as per specification no. P-SPC-003 for carrying out 3-layer polyethylene coating. The minimum thickness of finished coating shall be as follows:  
  
12" = 2.5 mm
- IV. Handling, transportation, loading/ unloading and stacking/ storing of bare/ coated line pipes within the coating yard.
- V. Cleaning and surface preparation of pipes, application of 3-layer side extruded polyethylene coating on bare line pipes, carrying out inspection and testing, repairing of coating defects, re-testing, any cutting of pipes for the purpose of PQT or regular production testing, carrying out re-beveling and all associated works after cutting etc. and carrying out all coating works as per specification no. P-SPC-003. Application shall also include coating of pipes of nonstandard lengths obtained in case of cutting of bare pipes necessitated for removal of dents/defects.
- VI. Pipe surfaces shall be cleaned to SA 2½ (in accordance with ISO 8502 -3) using suitable grit/ shot, free of any deleterious contamination or moisture. The surface roughness shall be checked at random and shall be of the range of 30-60 microns in accordance with ISO 4287-1.
- VII. Loose dust and residual abrasive, which may be developed inside the pipe during blasting process, shall be removed by high pressure air blow.
- VIII. The coating plant details shall be included in the bid.

**6.2 Materials to be supplied by Bidder**

Bidder shall procure and supply in sequence and at appropriate time, all corrosion coating materials, repair materials, all accessories, consumables and utilities required for completion of works. The rates quoted for the execution of the work shall be inclusive of supply of these materials. All materials supplied shall be strictly in accordance with the requirements of relevant applicable Company specifications enclosed.

Materials to be supplied shall include, but not limited to, the following:

- a. All materials and equipment required for repair, re-beveling and / or cutting out defects of bare pipes.
- b. All consumables, equipment required for surface cleaning / preparation etc.
- c. All coating materials and other materials, equipment, consumables as required for coating.

- d. All materials and equipment required for conducting all types of inspection and tests including non-destructive testing of pipes after rebeveling/ grinding.
- e. All materials and equipment required for repairing of defects of coated pipes and thereafter re-testing.
- f. All equipment, tools, tackles, trucks/ trailers, devices required for loading, transportation, hauling, handling, unloading, stacking, and storage of bare/ coated pipes.
- g. Any other items not mentioned above but required for timely completion of work in all respect.

**6.3 Works associated with Storage Yards.**

- i. Number of layers for pipes in storage yard shall be chosen so as to ensure safe handling of pipes and free movement of trailers.
- ii. Calculation for stacking arrangement for bare/ coated pipes and number of layers of pipes at Storage Yards shall be submitted by the coating contractor and approved by the Company.
- iii. Pipes of different thicknesses shall be stacked separately.
- iv. Bidder shall inspect all bare & coated line pipes in presence of company representative while handing over of pipes. Repair of damaged pipes, beveled end defects and damaged coating (including supply of coating materials for repair) noticed at the time of handing over of bare/ coated pipes. All handling, lifting tools etc. required for inspection of coated/ bare line pipes at Storage Yards shall be carried out by the bidder.
- v. Bidder shall provide temporary internal roads duly compacted for movement of cranes/trailers within the Storage Yards, as per the relevant drawings and other requirements indicated in the Contract document, making temporary approach road as required to the Storage Yards from the nearest main road.
- vi. A typical layout of Storage Yards, sketch is enclosed for reference purposes. Bidder shall develop a detailed development plan of Storage Yards including approach road.
- vii. The bare/coated pipes within the Storage Yards may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. Supply of sand and other materials shall be in Bidder's scope. This cover may consist of dry, germ free straw with a plastic film, otherwise foam rubber shall be used. The support shall be spaced in such a manner as to avoid permanent bending of the pipes. Bare pipe stacks shall consist of limited number of layers so that overstressing & deformation of the pipe is avoided.
- viii. In case of coated pipes, stacks shall consist of limited number of layers so that the pressure exercised by the pipe's own weight does not cause deformation of the line pipe/ damages to coating. Each section shall be separated by means of spacers suitably spaced for this purpose.
- ix. Bidder shall also be responsible for providing illumination at the Storage Yards. While unloading of pipes the illumination shall be 10 to 15 lux minimum and shall be provided. The required power for the lighting shall be arranged by the Bidder.
- x. The submission of prices by the Bidder shall be construed to mean that he has confirmed with all technical specifications of the corresponding item(s) and scope of work.

#### **4.4 Other Requirements**

- i. The coating plant, equipment, machinery and other facilities shall be in good operating condition to meet the job requirement of quality and production. Worn out or improvised plant are not acceptable. The coating plant(s) for the work shall be of size and capacity that shall be suitable for the scale of work, production rate, time schedule specified elsewhere in the tender document.
- ii. All external coating materials shall be as per specification no. P-SPC-003 and those for internal coating shall be as per details covered in this document. The bidder's proposed coating raw material supplier(s) shall be manufacturer of the materials meant for the three-layer side extruded polyethylene coating. He must have manufactured and supplied the offered grades of materials within the last five years reckoned from the bid due date. Bidder's offer shall be unconditional irrespective of the finally qualified raw material manufacturer(s).
- iii. All handling, loading, stacking/storing shall be done in such a manner as to minimize mechanical damages & corrosion and as per the procedure approved by the Company.
  - a. All handling shall be done with slings or padded hooks.
  - b. Trailers shall be cleaned of debris or any other substance that might damage the pipe
  - c. Suitable timber and other dunnage shall be used to protect the pipes against the damage during transit
  - d. Loading shall be done in accordance with API RP 5L1 and procedure approved by the Company.
  - e. Finished pipe to be stored for a significant period of time in the coating yard in a manner to prevent corrosion and damages to the coating.
- iv. A coating specialist shall be made available during entire duration of coating works. Coating wastage generated due to standard cut backs on external coating shall be the property of the Bidder.
- v. Any other works not listed specifically herein but required to be carried out by the Bidder in order to complete the job in all respects, shall also form a part of Bidder's scope.

#### **6.5 Inspection of Field Test and Warranty**

- I. Purchaser shall be reimbursed by Manufacturer for any pipe furnished on this order that fails under field hydrostatic test if such failure is caused by a material/manufacturing defect in the pipe. The reimbursement cost shall include pipe, labour and equipment rental for finding, excavating, cutting out, installation of replaced pipe in position, all incidental expenses and administrative costs.
- II. In case Manufacturer so desires, he will be advised at least two weeks in advance so that his representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative.

#### **7.0 ATTACHMENTS**

1. Typical layout of Storage Yards
2. Barbed wire fencing



**STANDARD SPECIFICATION FOR  
HIGH FREQUENCY WELDED (HFW)  
LINE PIPE (ONSHORE)**

**SPECIFICATION NO.  
P-SPC-002**

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**STANDARD SPECIFICATION FOR  
HIGH FREQUENCY WELDED (HFW)  
LINE PIPE  
(ONSHORE)**

**P-SPC-002**

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# STANDARD SPECIFICATION FOR HIGH FREQUENCY WELDED (HFW) LINE PIPE (ONSHORE)

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## ABBREVIATIONS

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
BM	Base Metal
CE	Carbon Equivalent
CVN	Charpy V-Notch
FBH	Flat Bottomed Holes
HAZ	Heat Affected Zone
ID	Inside Diameter
K <sub>vL</sub>	Charpy value in pipe longitudinal direction
K <sub>vT</sub>	Charpy value in pipe transversal direction
MPQT	Manufacturing Procedure Qualification Tests
MPS	Manufacturing Procedure Specification
NDT	Non Destructive Testing
OD/D	Outside Diameter, Specified
SAWL	Submerged Arc Longitudinal Welded
SMAW	Shielded Metal Arc Welding
$s_r$	Sizing ratio of the pipe
$t$	Wall Thickness, Specified
UT	Ultrasonic testing



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## 1 SCOPE

### 1.1 Coverage

This specification establishes the minimum requirements for the manufacture of high frequency welded steel line pipe in accordance with the requirements of API (American Petroleum Institute) Specification 5L, Forty-Sixth Edition, April 2018 and makes restrictive amendments to API Specification 5L. Unless modified and/or deleted by this specification, the requirements of API Specification 5L shall remain applicable.

The sections, paragraphs and annexes contained herein have the same numbering as that of API Specification 5L in order to facilitate reference. Additional requirements, which are not specified in API Specification 5L, have also been numbered and marked as "(New)".

The coverage by this specification is limited to line pipe to be used in onshore pipelines transporting non-sour hydrocarbons in liquid or gaseous phase. The product specification level for line pipe to be supplied as per this specification shall be "PSL 2".

### 1.2 Application of the API Monogram

The Manufacturer shall have a valid license to use API Monogram and line pipes supplied as per this specification shall bear API monogram in accordance with the requirements of Annex A of API Specification 5L, Forty—Sixth Edition, April 2018 for Product Specification Level PSL 2.

### 1.3 Pipe Size

This Specification shall be applied to line pipe of size 4.5" (114.3 mm) OD thru 20" (508.0 mm) OD (both sizes included).

## 2 NORMATIVE REFERENCES

The latest edition (edition enforce at the time of issue of enquiry) of following additional references are included in this specification:

ASTM E112 — 12: Standard Test Methods for Determining Average Grain size

## 6 PIPE GRADES AND STEEL GRADES, AND DELIVERY CONDITION

### 6.1 Pipe Grades and Steel Grades

6.1.2 Line pipe supplied to this specification shall conform to Product Specification Level 2 (PSL 2) as given in Table 1 of this specification and consists of an alpha or alphanumeric designation that identifies the strength level of the pipe. The steel name (designating a steel grade), linked to the chemical composition of the steel, additionally includes a suffix that consists of a single letter (M) that identifies the delivery condition as per Table 3 of this specification.

Table 1 of API Specification 5L stands replaced by Table 1 of this specification.

**Table 1 - Pipe Grade and Steel Grades, and Acceptable Delivery Conditions**

PSL	Delivery Condition	Pipe grade/ steel grade a,b
PSL2	Thermomechanical rolled	BM, X42M, X46M, X52M, X56M, X60M, X65M & X70M
a	Deleted	
b	The suffix (M) for PSL 2 grades belongs to steel grade	





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## 6.2 Delivery Condition

6.2.2 The delivery condition for starting material shall be in accordance with Table 1 of this specification.

## 8 MANUFACTURING

### 8.1 Process of Manufacture

Pipe furnished to this specification shall be manufactured in accordance with the applicable requirements and limitations given in Table 2 of API Specification 5L and Table 3 of this specification.

Table 3 of API Specification 5L stands replaced by Table 3 of this specification.

**Table 3 - Acceptable Manufacturing Routes for PSL 2 Pipe**

Type of pipe	Starting Material	Pipe forming	Pipe heat treatment	Delivery condition
HFW	Thermomechanical-rolled coil	Cold forming	Heat treating <sup>a</sup> of weld area only	M
a See clause 8.8 of this specification for applicable heat treatment				

High frequency electric welding shall be performed with a minimum welding current frequency of 200 kHz. The welding system shall have an integrated control in which following data as a minimum shall be monitored:

Welding Temperature Welding speed Current and Voltage

Abutting edges of the coil shall be milled or machined immediately before welding. The width of the coil shall be continuously monitored.

High frequency electric welding shall be performed with a minimum welding current frequency of 200 kHz. The welding system shall have an integrated control in which following data as a minimum shall be monitored:

- Welding Temperature
- Welding speed
- Current and Voltage

Abutting edges of the coil shall be milled or machined immediately before welding. The width of the coil shall be continuously monitored.

### 8.3 Starting Material

8.3.2 Line pipe furnished to this specification shall be made from steel produced in basic oxygen or electric arc furnace. Steel shall be made by continuous casting only.

8.3.3 The steel used for manufacture of pipe shall be fully killed and fine grained with ASTM grain size number 7 or finer as per ASTM E 112.

### 8.8 Treatment of Weld Seams in EW and LW Pipe

8.8.2 LW Pipe and PSL 2 HFW Pipe

The weld seam and the entire Heat Affected Zone (HAZ) shall be heat treated so as to stimulate a normalizing heat treatment in order to control the grain structure so that no untempered martensite remains in the weld seam and the HAZ, and the mechanical properties of heat treated zone approximate that of the parent metal.

Heat treatment temperature of the weld seam and the entire HAZ shall be continuously measured and recorded.

**8.9 Cold Sizing and Cold Expansion**

8.9.1 Pipes furnished to this specification shall be non-expanded.

**8.11 Jointers**

8.11.1 Jointers on pipes are not permitted.

**9 ACCEPTANCE CRITERIA**

**9.2 Chemical Composition**

9.2.2 For pipes supplied as per this specification, the chemical composition of each heat of steel on product analysis shall be as given in Table 5 of this specification.

Table 5 of API Specification 5L stands replaced by Table 5 of this specification.

**Table 5 — Chemical Composition for Pipe**

<b>Element</b>	<b>Mass Fraction based on Heat and Product Analyses (%)</b>	
C <sup>b</sup>	0.16	max. (For Grade BM to X56M)
	0.12 <sup>f</sup>	max. (For Grade X60M to X70M)
Si	0.15 <sup>m(New)</sup>	min.
	0.45	max.
Mnb	1.20	max. (For Grade BM to X46M)
	1.40	max. (For Grade X52M & X56M)
	1.60	max. (For Grade X60M & X65M)
	1.70	max. (For Grade X70M)
p	0.020	max.
S	0.015	max.
V	0.05	max. (For Grade BM to X46M)
	<sup>d</sup>	(For Grade X52M to X70M)
Nb	0.05	max. (For Grade BM to X46M)
	<sup>d</sup>	(For Grade X52M to X70M)
Ti	0.04	max. (For Grade B to X46M)
	<sup>d</sup>	(For Grade X52M to X70M)
Al <sup>n(New)</sup>	0.02 <sup>o(New)</sup>	min.
	0.07	max.
Cr	0.20	max.
Mo	0.10	max. (For Grade BM to X65M)
	0.20	max. (For Grade X70M)
Cu	0.35	max.
Ni	0.20	max.
N <sup>n(New)</sup>	0.012	max.



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Element	Mass Fraction based on Heat and Product Analyses (%)	
B	0.0005	max.
a	Based-on product analysis as per clause 9.2.4 and 9.2.5 of API Specification 5L, the $CE_{pcm}$ limits apply if $C < 0.12\%$ and $CE_{IIW}$ limits apply if $C > 0.12\%$ . For pipes of all grades, sizes and wall thicknesses, Carbon Equivalent shall comply with the following limits: $CE_{PCM} \leq 0.20\%$ $CE_{IIW} \leq 0.40\%$ Boron content shall be considered in $CE_{PCM}$ formula even if it is less than 0.0005%.	
b	Deleted	
c	Deleted	
d	$Nb + V + Ti < 0.15\%$	
e	Deleted	
f	Deleted	
g	Deleted	
h	Deleted	
i	Deleted	
j	Deleted	
k	Deleted	
l	Deleted	
m	Minimum for Si is not applicable for Al killed steel.	
n	Al/N shall be minimum 2 (not applicable to titanium-killed steel or titanium-treated steel).	
o	Applicable for Al killed steel only.	

9.2.3 For heat analysis and product analysis, all the elements listed in Table 5 of this specification shall be analysed and reported, even if those are not purposely added but are present as residuals only.

If alloying elements other than those specified in Table 5 of this specification are added to the steel, the limits of the additional components shall be agreed with the Purchaser.

### 9.3 Tensile Properties

9.3.2 The finished pipe (after all heat treatment & sizing operations) shall conform to the requirements of Table 7 of API Specification 5L and as modified herein.

The actual yield strength shall be as close as possible to the specified minimum yield strength (SMYS) but in no case it shall exceed the limits specified here under:

<u>API Specification 5L Grade</u>	<u>Permissible in excess of SMYS, MPa (psi)</u>
Upto and including X46M	131 (19,000)
X52M to X60M	125 (18,000)
X65M to X70M	120 (17,400)

The ratio of body yield strength and body tensile strength of each test pipe on which yield strength and ultimate tensile strength are determined, shall not exceed 0.90.

The tensile strength of the weld (after heat treatment of the weld seam) shall be equal to or higher than the specified minimum tensile strength of the base metal.

The minimum elongation of base metal shall be determined in accordance with the formula given in foot note (f) of Table 7 of API Specification 5L, however, minimum elongation in no case shall be less than 20%.

## 9.6 Flattening Test

Acceptance criteria for flattening tests shall be as follows:

- a) For HFW pipe of grade  $> X60$  and  $t > 12.7$  mm, there shall be no opening of the weld before the distance between the plates is less than 66% of the original outside diameter. For all other combinations of pipe grade and specified wall thickness, there shall be no cracks or breaks in either weld or parent metal before the distance between the plates is less than 50% of the original outside diameter. Dye penetrant testing shall be used to positively confirm the presence of crack, break or opening.
- b) For HFW pipe with a  $D/t > 10$ , there shall be no cracks or breaks other than in the weld before the distance between the plates is less than 33% of the original outside diameter.
- c) For all pipes, there shall be no evidence of lamination or burnt metal during the entire test before opposite walls of the pipe meet.

Note: The weld extends to a distance of 13 mm on each side of the weld line. The original outside diameter is the specified outside diameter.

## 9.8 CVN Impact Test for PSL 2 Pipe

### 9.8.1 General

- 9.8.1.2 From the set of three Charpy V-notch impact test pieces, only one is allowed to be below the specified average absorbed energy value and shall meet the minimum single absorbed energy value requirement as specified in Table G of this specification.

### 9.8.2 Pipe Body Tests

- 9.8.2.1 The average (set of three test pieces) absorbed energy value (KvT) for each pipe body test shall be as specified in Table G of this specification, based on full sized test pieces at a test temperature of 0°C (32°F) or at a lower test temperature as specified in the Purchase Order.
- 9.8.2.2 The minimum average (set of three test pieces) shear fracture area shall be at least 85 % with one minimum value of 75%, based at a test temperature of 0 °C (32 °F) or at a lower test temperature as specified in the Purchase Order.

### 9.8.3 Pipe Weld and HAZ Tests

The average (set of three test pieces) absorbed energy value (KvT) for each pipe weld and HAZ test shall be as specified in Table G of this specification, based on full-size test pieces at a test temperature of 0°C (32°F) or at a lower test temperature as specified in the Purchase Order.

## 9.10 Surface Conditions, Imperfections and Defects

### 9.10.1 General

- 9.10.1.2 All pipes shall be free from cracks, sweats, leaks and slivers. Pipe containing such defect shall be treated in accordance with clause C.3 b) or c) of API Specification 5L.

### 9.10.3 Arc Burns

- 9.10.3.2 Arc burns shall be treated in accordance with clause C.3 b) or c) of API Specification 5L. As a reference method for confirming the existence of an arc burn, the area shall be buffed with wire brush or sanding disc and etched with 10% solution of ammonium persulfate or a 5% solution of nital.

However, arc burns can be considered for acceptance, in case the same is re-crystallized by seam heat treatment. In such case, the Manufacturer shall demonstrate the re-crystallization to Purchaser by taking a sample as per clause 10.2.3.8 (New) of this specification.

9.10.4 Laminations

Any lamination or inclusion either extending into the face or bevel of the pipe or present within 50 mm from pipe ends shall be classified as defect. Pipes that contain such defects shall be rejected or cut back until no lamination or inclusion is present at the pipe ends and shall be treated in accordance with clause C.3 b) or c) of API Specification 5L.

9.10.5 Geometric Deviations

9.10.5.2 For dents, the length in any direction shall be  $< 0.5D$  and the depth, measured as the gap between the extreme point of the dent and the prolongation of the normal contour of the pipe, shall not exceed the following:

- a) 3.2 mm for cold-formed dents with sharp-bottom gouges and not encroaching upon the specified minimum wall thickness.
- b) 6.4 mm for other dents.
- c) 1 mm at the pipe ends, i.e. within a length of 100 mm at each of the pipe ends.
- d) Any dent on weld and heat affected zone (HAZ).

Dents that exceed the above specified limits shall be considered as defect and shall be treated in accordance with clause C.3 b) or c) of API Specification 5L. Acceptable cold-formed dents with sharp-bottom gouges shall be treated in accordance with clause C.2 of API Specification 5L & as modified in this specification.

9.10.6 Hard Spots

Any hard spot larger than 50 mm (2.0 in) in any direction and hardness greater than 248H Vio shall be classified as defect and treated in accordance with clause C.3 b) or C.3 c) of API Specification 5L.

9.10.7 Other Surface Imperfection

Other surface imperfections found by visual inspection or non-destructive inspection shall be investigated, classified and treated as follows:

- a) Imperfections that have a depth  $< 0.05t$  and do not encroach on the minimum specified wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1 of this specification.
- b) Imperfections that have a depth  $> 0.05t$  and do not encroach on the minimum specified wall thickness shall be classified as defects, and shall be dressed-out by grinding in accordance with Clause C.2 of API Specification 5L and as modified in this specification or shall be treated in accordance with clause C.3 b) or c) of API Specification 5L.
- c) Imperfections that encroach on the minimum specified wall thickness shall be classified as defects and treated in accordance with clause C.3 b) or c) of API Specification 5L

**9.11 Dimensions, Mass and Tolerances**

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

9.11.3.1 The diameter and out-of-roundness shall be within the tolerances given in Table 10 of this specification.

Table 10 of API Specification 5L stands replaced by Table 10 of this specification.

**Table 10 - Tolerances for Diameter and Out-of-roundness**

Specified Outside Diameter (D) mm (in)	Diameter Tolerances <sup>d</sup>		Out-of-roundness Tolerance <sup>e(new)</sup>	
	Pipe Except the End <sup>a</sup>	Pipe End <sup>a,c</sup>	Pipe Except the End <sup>a</sup>	Pipe End <sup>a,c</sup>
$D \leq 168.3 (6\frac{1}{2})$	$\pm 0.0075 D$	-0.4 mm to + 1.6 mm	$0.020D$	0.015 D upto a maximum of 2.0mm
$168.3 (6\frac{1}{2}) < D \leq 273.1 (10\frac{3}{4})$	$\pm 0.0075 D$	$\pm 0.005 D$	$0.020D$	2.0mm
$D > 273.1 (10\frac{3}{4})$	$\pm 0.0075 D$ upto a maximum of $\pm 3.0$ mm	$\pm 1.6$ mm	$0.020D$	3.0mm

a The pipe end includes a length of 100 mm at each of the pipe extremities.  
b Deleted.  
c The diameter tolerance and out-of-roundness tolerance shall apply on inside diameter. The inside diameter, based on circumferential measurement, shall be calculated as  $ID = (D - 2t)$ .  
d For determining compliance to the diameter tolerances, the pipe diameter is defined as the circumference of the pipe in any circumferential plane divided by Pi (x).  
e Out-of-roundness tolerances apply to maximum and minimum diameters as measured with bar (New)gage, caliper, or device measuring actual, maximum and minimum diameters.

9.11.3.2 In addition to API requirements, the wall thickness of each pipe shall be checked along the circumference at both ends and at the mid location of pipe body at 12 O' clock, 3 O' clock, 6 O' clock and 9 O' clock positions. The tolerances for wall thickness shall be as given in Table 11 of this specification.

Table 11 of API Specification 5L stands replaced by Table 11 of this specification.

**Table 11 - Tolerances for Wall Thickness**

Wall Thickness (mm)	Tolerances <sup>c,d</sup> (mm)
$t < 15.0$ mm	+ 0.20 t -0.0 t
$t \geq 15.0$ mm	+3.0mm -0.0mm

a Deleted  
b Deleted  
c The + ve tolerance for wall thickness does not apply to the weld area.  
d See 9.13.2 of API Specification SL and as modified herein for additional restrictions.

9.11.3.3 All pipes shall be supplied with length between 11.5 m and 12.5 m. However pipe with length between 10.0 m and 11.5 m can also be accepted for a maximum of 5% of the ordered quantity. The minimum average length of the entire ordered quantity in any case shall be 12.0 m. Overall length tolerance shall be (-) Zero and (+) One pipe length to complete the ordered quantity. Table 12 of API Specification 5L stands deleted.



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9.11.3.4 The tolerances for straightness shall be as follows:

a) The total deviation from a straight line over the entire pipe length shall not exceed 12 mm, as shown in Figure 1 of API Specification 5L.

b) The local deviation from straight line in 1.0 m (3.0 ft) portion at each pipe end shall be < 3.0 mm (0.120 in), as shown in Figure 2 of API Specification 5L.

## 9.12 Finish of Pipe Ends

9.12.5 Plain Ends

9.12.5.6 During removal of inside burrs at the pipe ends, care shall be taken not to remove excess (New) metal and not to form an inside cavity on bevel. Removal of excess metal beyond the minimum wall thickness as indicated in clause 9.11.3.2 of this specification shall be a cause for re-bevelling. In case root face of bevel is less than that specified, the pipe ends shall be re-bevelled and rectification by filing or grinding shall not be done.

9.12.5.7 Bevel Protectors

Both pipe ends of each pipe shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard. Bevel protectors shall be of a design such that they can be re-used by coating applicator for providing on externally anti-corrosion coated pipes subsequent to coating of line pipe.

## 9.16 Reverse Bend Test

All pipes shall meet the minimum acceptance criteria for Reverse Bend Test as follows:

A specimen which fractures completely prior to the engagement of mandrel and specimen as specified in clause 10.2.4.9 (New) of this specification, or which reveals cracks or ruptures in the weld or heat affected zone longer than 4 mm shall be rejected. Cracks less than 6 mm long at the edges of the specimen shall not be cause for rejection. Dye penetrant testing shall be used to positively confirm cracks or openings.

## 10 INSPECTION

### 10.1 Types of Inspection and Inspection Documents

10.1.3 Inspection Documents for PSL 2 Pipes

10.1.3.1 Inspection certificate 3.2 in accordance with EN 10204 shall be issued for each dispatched pipe by Purchaser's authorized representative.

### 10.2 Specific Inspection

10.2.1 Inspection Frequency

10.2.1.2 For PSL 2 pipe, the inspection frequency shall be as given in Table 18 of this specification.

Table 18 of API Specification 5L stands replaced by Table 18 of this specification.

**Table 18 — Inspection Frequency of Pipe**

Sl. no.	Type of Inspection	Frequency of Inspection
1.	Heat analysis <sup>a</sup>	One analysis per heat of steel
2.	Product analysis <sup>b</sup>	Two pipes per lot (max. 100 pipes) per heat



Sl. no.	Type of Inspection	Frequency of Inspection
3.	Tensile testing of the pipe body	Two pipes per test unit of not more than 100 pipes per heat
4.	Tensile testing of the longitudinal weld seam of pipe <sup>c</sup>	Two pipes per test unit of not more than 100 pipes per heat
5.	CVN impact testing of the pipe body	Once per test unit of not more than 50 pipes
6.	CVN impact testing of the weld and HAZ of pipe <sup>c</sup>	Once per test unit of not more than 50 pipes
7.	Flattening test of pipe	Same as Figure 6 a) of API Specification SL
8.	Reverse Bend Test (New)	Same as Figure 6 a) of API Specification SL
9.	Hardness testing	Any hard spot exceeding 50 mm (2.0 in) in any direction
10.	Hydrostatic testing	Each pipe
11.	Weighing of pipe	Each pipe shall be measured and recorded
12.	Wall thickness measurement d	Each pipe
13.	Pipe diameter and out-of-roundness <sup>d</sup>	Each pipe
14.	Length	Each length of pipe shall be measured and recorded
15.	Straightness <sup>d</sup>	Each pipe
16.	Tolerances for the weld seam <sup>d</sup> a) Radial offset of coil edges b) Height of flash and c) Depth of groove after trimming of inside flash	Each pipe
17.	Visual inspection	Each pipe
18.	Metallographic testing (including Vicker's hardness test) of the longitudinal seam weld of pipe as defined in clause I 0.2.5 of this specification	At least one finished pipe from each lot of 50 pipes per heat or at least once per operating shift (12 hrs max.) whichever is occurring more frequently and whenever changes of grade, diameter or wall thickness are made and whenever significant excursions from operating heat treatment conditions are encountered and at the beginning of the production of each combination of specified outside diameter and specified wall thickness.
19.	Other dimensional testing	Random testing, with the details left to the discretion of the manufacturer
20.	Non-destructive inspection	In accordance with Annex E of API Specification 5L and as modified herein



Sl. no.	Type of Inspection	Frequency of Inspection
a)	Where the steel mill is not a part of an integrated pipe mill, heat analysis shall be reported by the Manufacturer prior to start of pipe production.	
b)	Pipes selected shall be such that one at the beginning of the heat and one at the end of the heat are also represented.	
c)	Pipe produced by each welding machine shall be tested at least once per week.	
d)	Measurement shall be recorded at least 3 times per operating shift (12 hrs maximum).	
e)	"Test unit" is as defined in clause 3.1.60 of API Specification 5L.	

10.2.2 Samples and Test Pieces for Product Analysis

Samples shall be taken, and test pieces prepared, in accordance with ISO 14284 or ASTM E1806. Samples used for product analysis shall be taken from finished pipes only.

Samples for product analysis from coil may be used provided the traceability of samples is guaranteed.

10.2.3 Samples and Test Pieces for Mechanical Tests

10.2.3.1 **General**

In addition to API Specification 5L requirements, samples and test pieces for various types of tests shall be taken from Figure 5 b) and Figure 6 a) of API Specification 5L and Figure 10.2.4.9.1 & 10.2.5.3.2 of this specification, whichever is applicable, and as given in Table 20 of this specification.

Table 20 of API Specification 5L stands replaced by Table 20 of this specification.

**Table 20 — Number, Orientation and Location of Test Pieces  
per Sample for Mechanical Tests for PSL2 Pipe**

Sample Location	Type of Test	Number, Orientation and Location of Test Pieces per Sample <sup>a</sup>	
		Specified Outside Diameter, <i>D</i> mm (inch)	
		< 219.1 (8.625)	≥ 219.1 (8.625)
Pipe body	Tensile	1L90	1T180
	CVN	3T90	3T90
Seam Weld	Tensile	--	IWb
	CVN	3Wand3HAZ	3Wand3HAZ
	Hardness	I W (As shown in figure 10.2.5.3 of this specification)	
Pipe body and weld	Flattening	As shown in figure 6 a) of API Specification SL	
	Reverse Bend	As shown in figure 10.2.4.9.1 of this specification	
<p>a See figure 5 (b) of API Specification 5L for an explanation of the symbols used to designate orientation and location.</p> <p>b Test specimen shall be tested for ultimate tensile strength only.</p>			



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## 10.2.3.2 Test Pieces for the Tensile Test

Rectangular test pieces, representing the full wall thickness of the pipe, shall be taken in accordance with ASTM A370 and as shown in Figure 5 b) of API Specification 5L.

Longitudinal tensile tests for pipe body with specified outside diameter,  $D < 219.1$  mm (8.625 inch) shall be carried out on a strip specimen representing full wall thickness of the pipe prepared according to ASTM A370.

Transverse tensile test for pipe body with specified outside diameter,  $D \geq 219.1$  mm (8.625 inch) shall be carried out on flattened rectangular test pieces.

For tensile test piece, both inside and outside flash of weld in excess of pipe wall thickness shall be removed from the test piece either by grinding or machining.

## 10.2.3.3 Test Pieces for the CVN Impact Test

In addition to the **API** Specification 5L requirements, following shall also be applicable:

The test pieces shall be prepared in accordance with ASTM A370. Non-flattened test pieces shall be used. The axis of the notch shall be perpendicular to the pipe surface.

Charpy V-notch impact testing shall be performed on full—sized test pieces. However, if preparation of full size test piece is not possible, then standard sub-sized test pieces shall be prepared as per ASTM A370.

Lower pipe sizes wherein preparation of transverse sub-sized specimen is not possible, CVN impact testing shall be carried out on longitudinal test specimen [see Note 'a' of Table G of this specification].

## 10.2.3.7 Test Pieces for Flattening Test

The test pieces shall be prepared in accordance with ISO 8492. The length of each test piece shall be  $> 60$  mm.

Minor surface imperfections may be removed by grinding.

## 10.2.3.8 Test Pieces for Macrographic and Metallographic Tests

Test piece for metallographic testing shall be taken transverse to the longitudinal weld sea as indicated in Figure 10.2.5.3 of this specification. The test piece shall be suitably ground, polished and etched to reveal the macro—structure.

## 10.2.3.9 Test Pieces for Reverse bend test

Ring specimen of width between 100 mm to 115 mm shall be taken from the pipe. Reverse bend test shall be carried out as per clause 10.2.4.9 (New) of this specification.

## 10.2.4 Test Methods

### 10.2.4.3 CVN Impact Test

The Charpy test shall be carried out in accordance with ASTM A370.

### 10.2.4.7 Flattening Test

In addition to the API Specification 5L requirements, following shall also be applicable:

The flattening test shall be carried out in accordance with ISO 8492.

### 10.2.4.9 Reverse Bend Test

The mandrel shall be plunged into the test piece prepared in accordance with clause 10.2.3.9 of this specification, with the weld in contact with the mandrel, to such a depth that the angle of engagement between mandrel and specimen reaches 60° as shown in figure 10.2.4.9.1 of this specification. If the combination of diameter & wall thickness of pipe and radius of mandrel is such that the angle of engagement cannot reach 60°, then the mandrel shall be plunged into the specimen until opposite walls of the specimen meet.

Selection of Mandrel

The reverse bend test shall be carried out with a mandrel, whose radius (R), or width (A) shall be calculated for any combination of diameter, wall thickness and grade with the following formula:

$$A = 2R = \frac{1.4 (D - t) t}{e (D - 2t) - 1.4t} - t$$

Where,

*D* Specified outside diameter of pipe, mm

*t* Specified wall thickness of pipe, mm

1.4 Peaking factor

*e* Strain

Minimum value of 'e' shall be as per Table 23 of API Specification 5L reproduced as below:

**Table 23- Strain Values for Guided-bend Test**

Pipe Grade	Strain Value 'e'
Gr. B	0.1375
X42	0.1375
X46	0.1325
X52	0.1250
X56	0.1175
X60	0.1125
X65	0.1100
X70	0.1025

10.2.5 Macrographic and Metallographic Tests

10.2.5.3 The test piece shall be visually examined using a minimum 40X magnification to provide evidence that heat treatment of weld zone is adequate and there is no untempered martensite or detrimental oxides from the welding process present along the weld seam. The metallographic examination shall be documented on micrographs (at 10X to 20X magnification). In case imperfections or defects are observed, it will become a cause for reevaluation of welding parameters and heat treatment as deemed necessary by Purchaser's Representative.

Vickers hardness tests shall be carried out on each test piece taken for metallographic examination in accordance with ISO 6507-1, at locations indicated in Fig. 10.2.5.3 of this specification. Indentation in the HAZ shall start as close to the fusion line as possible. The resulting Vickers hardness value at any point shall not exceed 24811V10. The maximum difference in hardness between the base metal and any reading taken on the weld or heat affected zone shall be less than 80HVio. Modalities of retest shall be in accordance with clause 10.2.12.7 of API Specification 5L.



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- 10.2.6 Hydrostatic Test
- 10.2.6.1 Test pressure shall be held for a minimum period of 15 seconds for all sizes and grades of pipes.
- 10.2.6.2 In addition to the requirements of API Specification 5L, following shall also be applicable:
- The pressure gauge used for hydrostatic testing shall have a minimum range of 1.5 times and maximum range of 4 times the test pressure. The test-pressure measuring device shall be calibrated by means of a dead-weight tester only. The test configuration shall permit bleeding of trapped air prior to pressurization of the pipe.
- 10.2.6.5 The test pressure for all sizes and grades of pipe shall be such that hoop stress (fibre stress) generated is at least 95% of SMYS, computed based on the Equation (6) indicated in clause 10.2.6.5 of API Specification 5L. Table 26 of API Specification 5L stands deleted.
- 10.2.7 Visual Inspection
- 10.2.7.1 Each pipe shall be visually examined for entire external surface and internal surface to the extent feasible and shall be free of defects in finished condition. Visual examination shall be carried out in a sufficiently illuminated area; minimum 1000 lx. If required additional lights shall be used to obtain good contrast and relief effect between imperfections and backgrounds.
- 10.2.8 Dimensional Testing
- 10.2.8.1 Diameter measurements shall be made with a circumferential tape only.
- 10.2.8.7 The measuring equipment requiring calibration or verification under the provisions of API Specification 5L shall be calibrated with manual instruments at least once per operating shift (12 hours maximum). Such calibration records shall be furnished to Purchaser's Representative on request.
- 10.2.10 Non-destructive Inspection
- Non-destructive inspection shall be performed in accordance with Annex E of API Specification 5L and as modified herein.
- 10.2.11 Reprocessing
- This clause of API Specification 5L stands cancelled.
- 10.2.12 Retesting
- 10.2.12.1 Recheck Analyses
- Modalities of recheck analysis shall be as per API Specification 5L as applicable to the lot being tested (see Table 18 of this specification). However, during individual testing, each pipe shall be fully analyzed to meet the requirements of Table 5 of this specification.
- 10.2.12.9 Reverse Bend Retests
- Reverse bend retest provisions shall be same as specified for flattening retests in clause 10.2.12.3 of API Specification 5L.
- 11 MARKING**
- 11.1 General**
- 11.1.1 Pipe manufactured in accordance with this specification shall be marked by the manufacturer as per the requirements of API Specification 5L and as modified herein. Marking shall be in English language and International System (SI) of Units.
- 11.1.5 Marking shall also include Purchase Order number, item number, pipe number and heat number.

**11.2 Pipe Markings**

- 11.2.1 **k)** Actual length in metres and actual pipe weight in kilogram shall be marked.
- 11.2.3 **c)** Paint used for stencil marking shall withstand a temperature up to 250°C expected to be experienced during further external anti-corrosion coating operations of line pipe by coating applicator.
- 11.2.4 The pipe number shall be placed by cold rolling or low stress dot marking or vibro-etching on the outside surface of the pipe at an approximate distance of 50 mm from both ends. In case of non-availability of either cold rolling or low stress dot marking facility in pipe mill, an alternative marking scheme of a permanent nature may be proposed by the Manufacturer.
- 11.2.8 A colour code band shall be marked on inside surface of finished pipe for identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order.
- The colour code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

**12 COATINGS AND THREAD PROTECTORS**

- 12.1.1 Unless otherwise specified in the Purchase Order, the pipes shall be delivered bare, free of any trace of oil, stain, grease and paint. Varnish coating shall be applied on the marking area. Bevels shall be free of any coating.

**13 RETENTION OF RECORDS**

In addition to the records indicated in API Specification 5L, the Manufacturer shall retain the records of all additional tests and calibration records mentioned in this specification including the hard copy records of ultrasonic testing carried out on pipe/coil as well as pipe ends.

**15 PRODUCTION REPORT**

The Manufacturer shall provide one electronic copy and six hard copies of production report in English language indicating at least the following for each pipe. International system of units (SI) shall be adopted.

- Pipe number
- Heat number from which pipe is produced
- Pipe length and weight
- Pipe grade

The Manufacturer shall provide one electronic copy and six hard copies of acceptance certificates which shall include the results of all tests required as per this specification and performed on delivered material giving details of, but not limited to, the following:

- All test certificates as per clause 10.1.3 of API Specification 5L and as modified herein.
- Records of qualification of welders and procedures for repair welding.
- Certified reports of dimensional inspection, surface imperfections & defects.
- Data on test failures, rejected heats/lots, etc.
- All other reports and results required as per this specification.

The certificates shall be valid only when signed by the Purchaser's Representative. Only those pipes, which have been certified by the Purchaser's Representative, shall be dispatched from the pipe mill.



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In the event of small quantities of pipes supplied against this specification, the production report may consist of only test certificates required as per clause 10.1.3 of API Specification 5L and as modified herein and other test reports/results required as per this specification.

## **16 INSPECTION OF FIELD TESTS & WARRANTY**

Purchaser shall be reimbursed by Manufacturer for any pipe furnished on this order that fails under field hydrostatic test if such failure is caused by a material/ manufacturing defect in the pipe. The reimbursement cost shall include pipe, labour and equipment rental for finding, excavating, cutting out and installation of replaced pipe in position. The field hydrostatic test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 95 % of specified minimum yield strength.

In case Manufacturer so desires, he will be advised at least two weeks in advance so that his Representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative.



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## ANNEX B

### MANUFACTURING PROCEDURE QUALIFICATION FOR PSL 2 PIPE

#### B.1 INTRODUCTION

B.1.1 This annex specifies additional provisions that apply for the PSL 2 pipes ordered as per this specification.

B.1.2 Two lengths each of completely finished pipes from two different heats (i.e. a total of four pipe lengths) shall be selected at random for testing as per clause B.5.1 of this specification to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The pipes thus tested shall be considered to be the test pipes required per heat or per lot as per relevant clauses of this specification.

These manufacturing procedure qualification tests (MPQT) shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser's Representative. The manufacturing procedure qualification tests shall be carried out on pipes for each wallthickness, each diameter and each grade of steel.

B.1.3 Verification of the manufacturing procedure shall be by qualification in accordance with clause B.3, B.4 and B.5 of API Specification 5L and as modified herein.

Note: In the event of small quantities of pipes (i.e. less than 50 numbers) ordered against this specification, like those for bends and other similar applications, as specifically called out in the Purchase Order, the manufacturing procedure qualification test as per clause B.5.1 of this specification shall not be carried out. Pipes in such case shall be accepted based on regular production tests.

#### B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION

Before pipe production commences, Manufacturing Procedure Specification (MPS) for manufacturing of pipes and Statistical process control charts shall be prepared by pipe manufacturer (including all information as per clause B.3 a), b) and e) of API Specification 5L) and submitted for approval of the Purchaser.

#### B.5 MANUFACTURING PROCEDURE QUALIFICATION TESTS (MPQT)

B.5.1 For the qualification of the manufacturing procedure, all tests & inspections specified in Table 18 and clause B.5.2 of this specification shall be conducted on all the pipes selected for testing as per clause B.1.2 of this specification.

B.5.2 The Manufacturer shall submit to Purchaser a report giving the results of all tests mentioned below. The report shall be agreed and signed by Purchaser's Representative, prior to start of regular production.

The various tests to be conducted on each pipe shall be as follows. The test method and acceptance values shall be as per this specification unless specified differently in this Annex.

##### a. Visual Examination

All pipes shall be examined visually for dimensional tolerances and apparent surface defects.

##### b. Ultrasonic Examination

The weld seam of all pipes shall be examined ultrasonically by automatic ultrasonic equipment.

##### c. Mechanical Properties



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The mechanical properties of all pipes shall be tested and shall meet the requirements of this specification. Purchaser's Representative will select the places in pipe from where the test pieces shall be extracted.

The following tests shall be conducted:

i. Flattening Test

Two (2) flattening test pieces shall be extracted; one test piece shall be tested with weld at 0° and other at 90°.

ii. Tensile Test

Tensile tests shall be conducted on:

*For pipe with specified outside diameter,  $D < 219.1$  mm (8.625 inch):*

— Two (2) longitudinal test pieces from base metal

*For pipe with specified outside diameter,  $D \geq 219.1$  mm (8.625 inch):*

— Two (2) transverse test pieces from base metal

— Two (2) transverse test pieces from the longitudinal weld seam

iii. Metallographic Tests

Six (6) weld cross—section test pieces, three (3) from each end of pipe weld seam shall be taken for metallographic examination. Two (2) of these shall be tested for hardness at room temperature after etching, one from each end of pipe.

iv. CVN Impact Testing

CVN impact test shall be performed on test pieces extracted as follows:

— Five (5) sets of three (3) transverse test pieces each from base metal

— One (1) set of three (3) transverse test pieces with weld in middle

— One (1) set of three (3) transverse test pieces with HAZ in middle

The minimum average (set of three test pieces) absorbed energy value (Kv  $T$ ) at the test temperature specified in clause 9.8 and Table G of this specification shall be complied with for test pieces extracted from Base Metal, Weld and HAZ.

v. Fracture Toughness Testing

Five (5) sets of CVN Base Metal test pieces shall be tested at — 40 °C, —20 °C, — 10°C, 0°C and + 20° C for shear area and absorbed energy to produce full transition curve. The minimum average (set of three test pieces) shear fracture area at the test temperature specified in clause 9.8 of this specification shall be complied with. For other temperatures, the value shall be for information only.



**ANNEX C**

**TREATMENT OF SURFACE IMPERFECTIONS AND DEFECTS**

**C.1 TREATMENT OF SURFACE IMPERFECTIONS**

Surface imperfection not classified as defect as per this specification shall be cosmetically dressed—out by grinding.

**C.2 TREATMENT OF DRESSABLE SURFACE DEFECTS**

C.2.3 Complete removal of defects shall be verified by local visual inspection and by suitable nondestructive inspection. To be acceptable, the wall thickness in the ground area shall be in accordance with clause 9.11.3.2 of this specification.

**ANNEX E**

**NON-DESTRUCTIVE INSPECTION FOR PIPE**

The Purchaser reserves the right to depute its Representative(s) to perform inspection and witness tests in all phases of manufacturing and testing starting from steelmaking to finished line pipe ready for shipment. Manufacturer shall comply with the provisions regarding inspection notice, plant access, compliance and rejection mentioned in the Annex Q (New) of this specification. The Manufacturer shall give the Purchaser reasonable notice of the starting date of normal production and the work schedule. Any action or omission on part of Purchaser's Representative shall not relieve the Manufacturer of his responsibility and obligation to supply material in strict accordance with this specification.

**E.1 QUALIFICATION OF PERSONNEL**

**E.1.1** All personnel performing NDT activities shall be qualified in the technique applied, in accordance with latest edition of ISO 9712, ISO 11484 or ASNT No. ASNT-TC-1A or equivalent.

All NDT shall be performed in accordance with written procedures. These procedures shall have prior approval of the Purchaser.

Inspector Qualification

Acceptable qualification for NDT inspectors shall be as specified below:

*(i) For UT*

For UT, at least one Level III qualified inspector shall be available to the mill for overall supervision. Level III inspectors shall be ASNT Level III or ACCP Professional Level III and certified in applicable method.

A level II inspector is required for shift supervision, manual weld inspection and calibration of all systems (both manual and automated).

*(ii) For all other NDT methods*

Evaluation of indications: Level II & Level III inspector

**E.3 METHODS OF INSPECTION**

**E.3.1 General**

**E.3.1.1** The electric weld of the pipe shall be inspected by ultrasonic methods (Refer Table E.1 of API Specification 5L) for full length (100%) for the entire thickness, using automatic ultrasonic equipment in accordance with clause E.5 of API Specification 5L and as modified in this specification.

**E.3.1.3** Location of NDT equipment in the manufacturer's facility shall be such that final inspection of weld seam of pipe shall be performed after hydrostatic testing.

**E.3.2 Pipe End Inspection — Welded Pipe**

**E.3.2.1** Pipe ends including weld at the pipe ends not covered by automatic ultrasonic equipment shall be inspected by manual ultrasonic equipment with same sensitivity and capability as automatic equipment, or, such non-inspected pipe end shall be cut-off. Records in accordance with E.5.4 of API Specification 5L shall be maintained.

**E.3.2.3** Ultrasonic inspection in accordance with the method described in ISO 10893-8 shall be used to verify that the 50 mm (2.0 inch) wide zone at each pipe end is free of any laminar imperfections in the circumferential direction.

E.3.2.4 Bevel face of each pipe end shall be magnetic particle inspected for the detection of laminar (New) imperfections in accordance with ISO 10893-5.

**E.5 ULTRASONIC AND ELECTROMAGNETIC INSPECTION**

**E.5.1 Equipment**

E.5.1.1 In addition to the API Specification 5L requirements, all automatic ultrasonic equipment shall have an alarm device, which continuously monitors the effectiveness of the coupling. The equipment for the automatic inspection shall allow the localization of both longitudinal and transverse defects corresponding to the signals exceeding the acceptance limits of the reference standard. The equipment shall be fitted with a paint spray or automatic marking device and alarm device for areas giving unacceptable ultrasonic indications. All ultrasonic testing equipment shall be provided with recording device. In addition, an automatic weld tracking system shall be provided for correct positioning of the probes with respect to weld centre.

**E.5.2 Ultrasonic and Electromagnetic Inspection Reference Standards**

E.5.2.1 The reference standard (calibration pipe) shall have the same specified diameter and wall thickness as specified for the production pipe being inspected.

E.5.2.2 Reference standards shall be of sufficient length to permit calibration of ultrasonic inspection equipment at the speed to be used in normal production.

The reference standard (calibration pipe) shall also be of the same material, type and have the same surface finish and heat treatment as the pipe being inspected.

**E.5.2.3 Reference Standards**

**E.5.2.3.1 Reference Standards for Pipe Weld UT:**

Reference standard shall contain as reference indicators i.e. machined notches as given in Table E.7 of this specification.

Table E.7 of API Specification 5L stands replaced by Table E.7 of this specification.

**Table E.7 — Reference Indicators**

Item	Reference Indicators		
	Number of Notches and Orientation <sup>a</sup>		Notch Type <sup>b</sup>
	OD	ID	
Weld Seam	1L	1L	N10
<p>a The symbol indicates the orientation of the notch i. e. L =Longitudinal. Reference indicators shall be located as per Figure E. 1 of this specification.</p> <p>b Dimensions of Notch type N10 shall be 0.1 t x 50 mm x 1 mm (Depth x maximum Length x maximum width), where, 't' is the specified wall thickness. The depth tolerance is ±15% of the specified notch depth or ±0.05 mm, whichever is greater.</p>			

**E.5.2.3.2 Reference Standards for Coil/ Pipe Body UT:**

Reference standard for the ultrasonic inspection of coil or pipe body (except the coil edges/pipe ends) shall contain continuous machined notch of following dimension:

- a) Width,  $w$ : 8 mm, with a tolerance  $+0.8/ - 0.0$  mm
- b) Depth,  $d$ :  $0.25 t < d < 0.5 t$ , where, 't' is the specified wall thickness

Reference standard for the ultrasonic inspection of coil edges (area adjoining weld seam)/ pipe ends shall have 6.4 mm (1/4 inch) diameter FBH of a depth  $0.5 t$ , where 't' is the specified wall thickness.

### **E.5.3 Instrument Standardization**

E.5.3.2 The instrument shall be calibrated with appropriate reference standard (refer E.5.2 of API Specification 5L and as modified herein) at following intervals:

- Once at the beginning of each operating shift (12 hours maximum)
- Once in between of each operating shift i.e. 3 hrs to 4 hrs after the first
- Every time there is change in probes or working condition of the UT machine.
- Every time the running of the system gives rise to doubts on its efficiency.

If during the above calibration verification, it is found that the equipment has not functioned satisfactorily in the opinion of the Purchaser's Representative, all the pipes or coils already inspected after the previous verification shall be inspected again at Manufacturer's cost.

### **E.5.5 Acceptance Limits**

E.5.5.2 For ultrasonic inspection of pipe/coil, any imperfection that produces an imperfection greater than the acceptable limits shall be treated as following:

**a)** Locations showing indications above the acceptance limits during automatic ultrasonic inspection may be re-examined by manual ultrasonic method. If no defects are located during re-examination, the original findings may be ignored. Additional scanning may be requested by Purchaser's Representative to check questionable areas.

### **E.5.6 Disposition of Defects Found by Ultrasonic and Electromagnetic Inspection**

Disposition of any imperfection in pipe/coil that produces an indication greater than the acceptable limits as specified in Table E.9 (New) of this specification shall be classified as defect and shall be given disposition as per (c) or (d) of E.10 of API Specification 5L.

## **E.7 RESIDUAL MAGNETISM**

E.7.2 The longitudinal magnetic field shall be measured on all sizes of pipes. Measurement on pipe in stack shall not be considered valid. Such measurements shall be taken on the root face or square cut face of finished plain-end pipes.

E.7.3 Measurements shall be made using Hall — effect gaussmeter only.

E.7.4 Measurements shall be made on each end of a pipe for 5% of the pipes produced but at least once per 4 hr per operating shift (12 hrs maximum).

E.7.6 Four readings shall be taken approximately  $90^\circ$  apart around the circumference of each end of the pipe. The average of the four readings shall not exceed 2.0 mT (20 gauss) and no single reading shall exceed 2.5 mT (25 gauss). All residual magnetism measurements shall be recorded.

## **E.8 LAMINAR IMPERFECTIONS IN THE PIPE BODY OF EW, SAW AND COW PIPES**

E.8.1 The coil, except the longitudinal coil edges (area adjoining weld seam), shall be ultrasonically tested for laminations using an oscillating or straight running pattern of probes in accordance with ISO 10893-9 amended as follows:

- The distance between adjacent scanning tracks shall be sufficiently small to ensure detection of minimum allowed imperfection size. The minimum coverage during automatic ultrasonic inspection shall be > 20 % of the coil surface uniformly spread over the area.
- Acceptance limit for laminar imperfection in the coil, except the longitudinal edges, shall be as per Table E.9 (New) of this specification. Disposition of defects shall be as per clause E.5.6 of this specification.

Table 3 of ISO 10893-9 stands replaced by Table E.9 (New) of this specification.

**E.9 LAMIMAR IMPERFECTIONS ALONG THE STRIP/ PLATE EDGES OR PIPE WELD SEAM OF EW, SAW AND COW PIPES**

The longitudinal edges of the coil (area adjoining weld seam) shall be 100% ultrasonically inspected in accordance with ISO 10893-9 amended as follows:

- UT shall be performed over 25 mm wide zone along each side of the trimmed longitudinal edges of the coil.
- Acceptance limit for laminar imperfection in the longitudinal edges of the coil shall be as per Table E.9 (New) of this specification. Disposition of defects shall be as per clause E.5.6 of this specification.

Table 2 of ISO 10893-9 stands replaced by Table E.9 (New) of this specification.

**Table E.9 — Acceptance Criteria for Laminar Imperfection in Coil/ Pipe Body**

Location	Maximum Individual Imperfection		Minimum Imperfection Size Considered			Maximum Population Density <sup>a</sup>
	Area mm <sup>2</sup>	Length <sup>b</sup> mm	Area mm <sup>2</sup>	Length <sup>b</sup> mm	Width <sup>c</sup> mm	
Coil, except the longitudinal edges	1000	100d	300	35	8	10 [per 1.0 m x 1.0 m]
Longitudinal edges of the coil	500	40	-	20	-	4 [per 1.0 m length]
<p>a Number of imperfections of size smaller than the maximum imperfection size and greater than the minimum imperfection size.</p> <p>b Length is the dimension at right angles to the scan track.</p> <p>c Width is the dimension parallel to the scan track.</p> <p>d Any planar imperfection which is not parallel to the coil surface is not acceptable.</p> <p>e For an imperfection to be larger than the minimum imperfection size, the minimum area, minimum length and minimum width given for the coil/ pipe body, all have to be exceeded.</p>						



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## **E.10 DISPOSITION OF PIPES CONTAINING DEFECTS**

- a) The repaired area shall be 100% rechecked by magnetic particle or ultrasonic inspection to ensure complete removal of defects. However, for repair of cosmetic type of defects, MPI may not be conducted if so directed by Purchaser's Representative on case to case basis. The pipes having a thickness less than the minimum allowed in accordance with this specification, after repair by grinding shall be treated for disposition in accordance with (c) or (d) of clause E.10 of API Specification 5L.

## **E.11 ROTARY ULTRASONIC INSPECTION OF PIPE (ALTERNATIVE METHOD)**

As an alternative, full pipe may be ultrasonically inspected after welding of longitudinal seam by rotary ultrasonic testing method (pipe in rotating condition) in accordance with ISO 10893-8 amended as follows:

- The coverage area during ultrasonic inspection shall be 100 % of the pipe body including weld seam, sides of the weld seam and pipe ends.
- The reference standard for the weld seam as per clause E.5.2.3.1 and Table E.7 of this specification shall be used for the rotary ultrasonic testing.

If the manufacturer opts for rotary ultrasonic testing of full pipe in accordance with this clause, then, the requirement for ultrasonic inspection as per clause E.3.1.1, E.3.2.3, E.8 and E.9 of API Specification 5L and as modified herein shall not be applicable.

**ANNEX G**

**PSL 2 PIPE WITH RESISTANCE TO DUCTILE FRACTURE PROPAGATION**

**G.1 INTRODUCTION**

G.1.1 This annex specifies additional provisions that apply for pipes ordered as per this specification.

**G.2 ADDITIONAL INFORMATION TO BE SUPPLIED BY THE PURCHASER**

G.2.1 CVN minimum average absorbed energy value (based on full-sized test pieces) for each test as per clause G.3.2 shall be as per Table G of this specification for BM, weld and HAZ.

Table G.1, G.2 & G.3 of API Specification 5L stands replaced by Table G of this specification.

**Table G — CVN Absorbed Energy Requirements for  
Pipe Body, Weld and HAZ of PSL 2 Pipe**

Pipe Grade	Full-size CVN Absorbed Energy (KvL) <sup>a,b</sup> [J]	
	Average	Minimum
BM	40	32
X42M	40	32
X46M	40	32
X52M	40	32
X56M	40	32
X60M	42	34
X65M	45	36
X70M	50	40
<p>a The required KvL (longitudinal direction test pieces) values shall be 50% higher than the required KvT values.</p> <p>b Testing shall be performed at a test temperature of 0°C (32°F) or at a lower temperature as specified in the Purchase Order.</p>		



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## ANNEX Q

### PURCHASER INSPECTION

#### Q.1 INSPECTION NOTICE

Advance notice shall be given by the manufacturer prior to the start of production to the purchaser to inspect/ witness the manufacturing activities including tests.

#### Q.2 PLANT ACCESS

The inspector representing the purchaser shall have unrestricted access, at all times while work of the contract of the purchaser is being performed, to all parts of the manufacturer's works that will concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy the inspector that the pipe is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

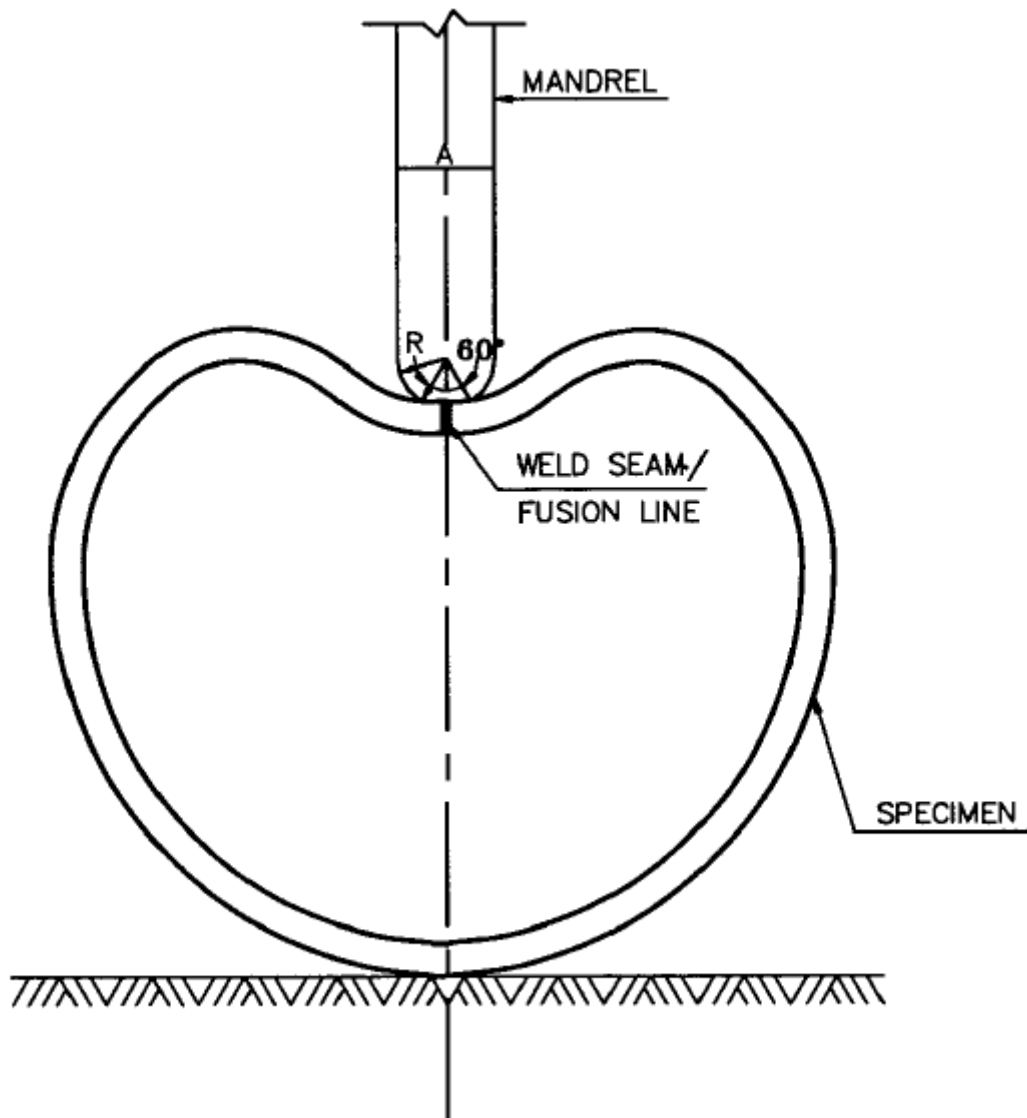
#### Q.3 COMPLIANCE

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to be satisfied of compliance by the manufacturer and any reject any material that does not comply with this specification.

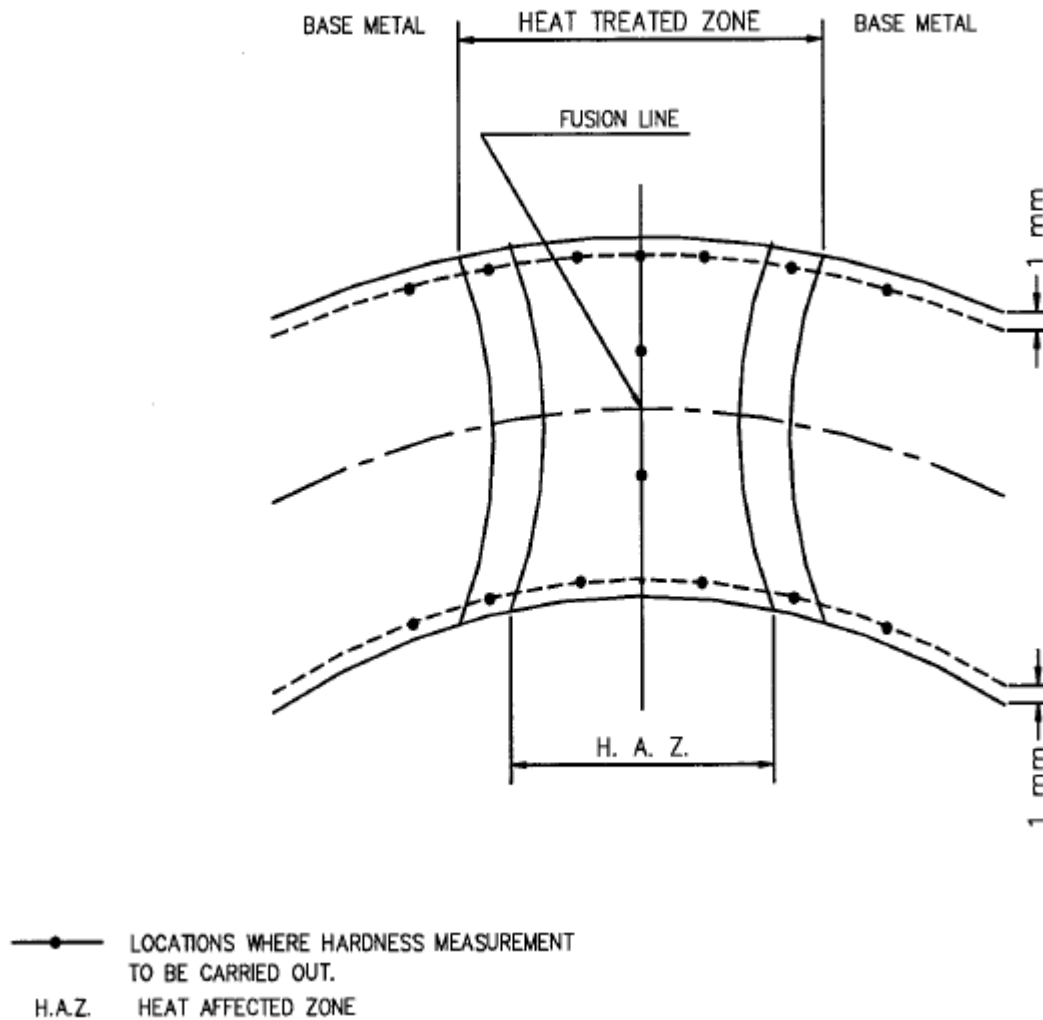
#### Q.4 REJECTION

If the Purchaser Representative rejects pipes repeatedly for any recurring cause, this shall be adequate reason to refuse final inspection of subsequent pipes until the cause has been investigated and corrective action taken by the Manufacturer.

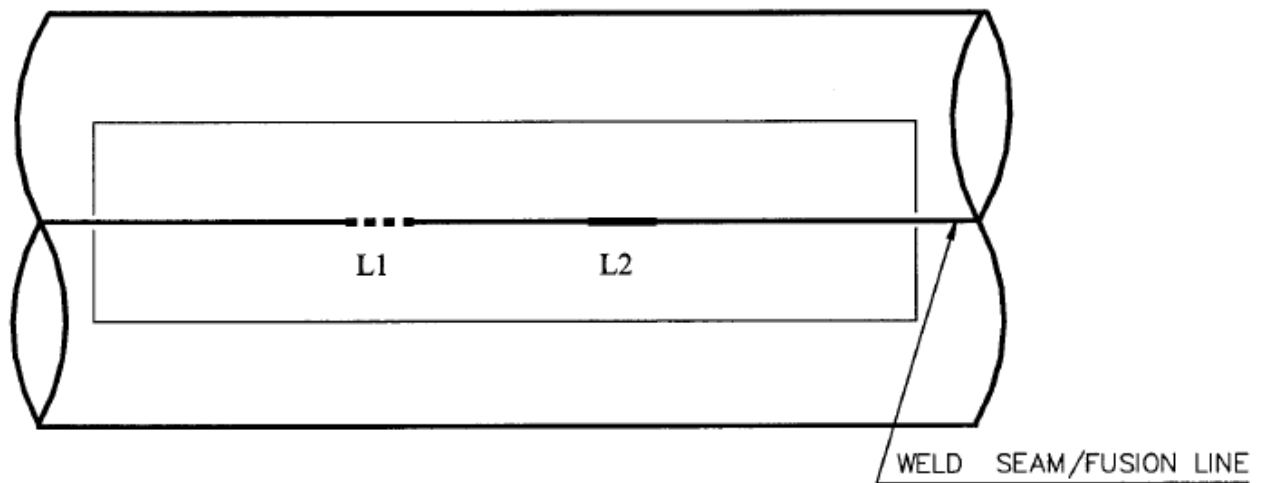




**FIGURE: 10.2.4.9.1  
REVERSE BEND TEST**



**FIGURE: 10.2.53  
METALLOGRAPHIC SPECIMEN AND LOCATIONS  
FOR HARDNESS MEASUREMENT**



- L1 - Longitudinal inside notch (N10) at weld line
- L2 - Longitudinal outside notch (N10) at weld line

**FIGURE: E.1**

**REFERENCE STANDARD FOR UT OF LONGITUDINAL WELD SEAM**



**STANDARD SPECIFICATION  
FOR  
3 LAYER POLYETHYLENE  
COATING OF LINEPIPES**

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**STANDARD SPECIFICATION  
FOR  
3 LAYER POLYETHYLENE COATING  
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0	05.01.2022	ISSUED AS STANDARD SPECIFICATION	RK	MD	AD	SK
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by



**STANDARD SPECIFICATION  
FOR  
3 LAYER POLYETHYLENE COATING  
OF LINEPIPES**

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P-SPC-003**

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**ABBREVIATIONS**

API	: American Petroleum Institute
APS	: Application Procedure Specification
ASME	: The American Society of Mechanical Engineers
ASTM	: American Society for Testing and Materials
CD	: Cathodic Disbondment/ Compact Disc
CSA	: Canadian Standards Association
<i>d</i>	: Days
DFT	: Dry film thickness
DIN	: Deutsches Institut for Normung
DNVGL	: Det Norske Veritas & Germanischer Lloyd
DSC	: Differential Scanning Calorimetry
EN	: European Standards
ESCR	: Environmental Stress Crack Resistance
FBE	: Fusion Bonded Epoxy
<i>h</i>	: Hours
HDPE	: High density polyethylene
ISO	: International Organization for Standardization
MFR	: Mass Flow Rate
PE	: Polyethylene
PP	: Polypropylene
ppd	: per pipe diameter
PQT	: Procedure Qualification Tests
RO	: Reverse Osmosis
SSPC	: The Society for Protective Coatings
<i>s</i>	: seconds
UV	: Ultraviolet



**STANDARD SPECIFICATION  
FOR  
3 LAYER POLYETHYLENE COATING  
OF LINEPIPES**

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## 1.0 SCOPE

This specification covers the minimum requirements for supply of all materials, plant, equipment, plant sites, consumables, utilities including all labour, supervision, inspection and tests etc. for plant-application of external anti-corrosion coating of pipes by using 'Three (3) Layer Side Extruded Polyethylene (3LPE)' conforming to ISO 21809 — 1: 2011 "Petroleum and natural gas industries — External coatings for buried and submerged pipeline transportation systems — Part 1: Polyolefin Coatings (3-layer PE and 3-Layer PP)" and the requirements of this specification.

## 2.0 REFERENCE DOCUMENTS

2.1 Reference has also been made to the latest edition (edition enforce at the time of issue of enquiry) of the following standards, codes and specifications. The edition enforce at the time of floating the enquiry shall be termed as latest edition.

API RP 5L 1	:	Recommended practice for railroad transportation of line pipe
API RP 5LT	:	Recommended practice for truck transportation of line pipe
API RP 5LW	:	Recommended practice for transportation of line pipe on barges and marine vessels
API Spec 5L	:	Specification for line pipe
ASME B31.4	:	Pipeline transportation systems for liquids and slurries
ASME B31.8	:	Gas transmission and distribution piping systems
ASTM D149	:	Standard Test Method of Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Frequencies
ASTM D257	:	Standard Test Methods for DC Resistance or Conductance of Insulating Materials
ASTM D790	:	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1603	:	Standard test method for carbon black content in olefin plastics
ASTM D1693	:	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D3895	:	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4940	:	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives
CSA Z245.20	:	Plant applied external coatings for steel pipe
DIN 30670	:	Polyethylene coatings on steel pipes and fittings - Requirements and testing
DNVGL-ST-F101	:	Submarine pipeline systems
DNVGL-RP-F102	:	Pipeline field joint coating and field repair of line pipe coating.
DNVGL-RP-F 106	:	Factory applied external pipeline coatings for corrosion control
DIN VDE 0433-2	:	Generation and measurement of high voltages; Specifications for voltage measurement by means of sphere gaps (one sphere earthed)
EN 10204	:	Metallic products — Types of inspection documents

ISO 306	:	Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)
ISO 572	:	Plastics — Determination of tensile properties Part 2 - Test conditions for moulded and extruded plastics Part 3 - Test conditions for films and sheets
ISO 868	:	Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)
ISO 1133	:	Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics
ISO 1183	:	Plastics — Methods for determining the density of non-cellular plastics
ISO2808	:	Paints and varnishes — Determination of film thickness
ISO 3146	:	Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods
ISO 8501	:	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness Part 1 - Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502	:	Preparation of steel substrate before application of paints and related products - Tests for the assessment of surface cleanliness Part 3 - Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method) Part 9 - Field method for the conductometric determination of water soluble salts
ISO 8503	:	Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates Part 1 - Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast cleaned surfaces Part 2 - Method of grading of surface profile of abrasive blast cleaned steel — Comparator procedure Part 4 - Method for the calibration of ISO surface profile comparators and for the determination of surface profile - stylus instrument procedure
ISO 9001	:	Quality Management Systems — Requirements
ISO 9002	:	Quality management systems -- Guidelines for the application of ISO 9001: 2015
ISO 11124	:	Preparation of steel substrates before application of paints and related products - Specifications for metallic blast-cleaning abrasives Part 1 - General introduction and classification Part 2 - Chilled-iron grit



Part 3 - High-carbon cast-steel shot and grit

Part 4 - Low-carbon cast-steel shot

ISO 11357 : Plastics — Differential scanning calorimetry (DSC)

ISO 15512 : Plastics — Determination of water content

ISO 21809 : Petroleum and natural gas industries — External coatings for buried or submerged pipelines transportation systems

Part 2 - Fusion-bonded epoxy coatings

Part 3 - Field joint coatings

SSPC SP1 : Steel Structures Painting Council — Solvent Cleaning

**2.2** The Applicator shall be familiar with the requirements of these documents and shall make them readily available at the coating plant to all persons concerned with carrying out the works specified in this specification.

**2.3** In case of conflict between the requirements of this specification, ISO 21809 —1 and the codes, standards and specifications referred in clause 2.1 above, requirements of this specification shall govern.

### **3.0 COMPLIANCE**

**3.1** The Applicator shall be responsible for complying with all applicable requirements of ISO 21809-1: 2011 and this specification. The Company reserves the right to make necessary investigation and, in case of doubt, ask the applicator to conduct additional testing, batch sampling and manufacturing inspection in order to be satisfied of compliance by the applicator. Any materials/coating that does not comply with the requirements shall be rejected.

### **4.0 PLANT SCALE AND INSTALLATION**

**4.1** Applicator shall size coating plant(s) after evaluating the scale of work and the time schedule required for the works. Coating plant(s), both new and existing, shall be installed into a yard whose geometry and dimensions are such as to allow the execution of a continuous work schedule. For this purpose, the Applicator shall ensure non-stop work execution owing to prohibitive adverse weather conditions and install requisite equipment and plant in roofed and adequately weather-protected areas.

**4.2** Plant equipment, machinery and other facilities shall be in finest operating condition to at least meet the job requirements of quality and production. Worn out and improvised plants are not acceptable.

**4.3** The epoxy spray booth shall be sized to accommodate the number of spray guns required for the application of required quantity of epoxy powder to be electrostatically sprayed on to the pipe to achieve specified thickness. Under no circumstances epoxy powder shall escape from the booth. This shall be clearly demonstrated by coating applicator during procedure qualification tests (PQT).

**4.4** Plant shall have a powder storage room hermetically controlled with power back up for Air conditioning capable of storing the coating materials as per coating manufacturer's recommendations. Temperature and relative humidity shall be recorded continuously.

**4.5** The powder system shall have an operational automatic fire suppressant system. Powder system shall have means to separate virgin and reclaimed powder.

**4.6** Plant shall have pipe internal blow-out and debris collection system to remove loose scale, dirt and abrasive from the pipe interior.

**4.7** The air used for the fluidization of epoxy powder shall be free from moisture. For this purpose



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dehumidifiers and/ or air dryer, as necessary shall be provided along with necessary monitoring and control system. Fluidized bed shall have magnets adequate to remove iron and steel shaving contaminant from recycled powder.

- 4.8** The conductivity of RO water should be less than 35 micro-siemens and rinse water pressure shall be minimum 1000 psi.
- 4.9** The Applicator shall, at his own responsibility and cost, provide and prepare all necessary area for the storage of bare and coated pipe and all other materials, for coating yard, stock-piling and other temporary installation. For each area, Applicator shall provide necessary agreements, as required, with the land owner(s)/relevant Authorities, and, on work completion, to clean and pay settlement and claims for damages, as applicable.
- 4.10** The Applicator shall at its own responsibility and cost, provide for water supply, power supply and other utilities, consumables and obtain authorization regarding access roads and other permits required for the execution of works conforming to all the requirements of the governing Authorities.
- 4.11** The Applicator shall at its own expense provide a fully equipped laboratory and test facilities with adequate inventory to carry out tests required for the procedure qualification and regular production. Outside testing for qualification and regular production is not acceptable to Company.
- 4.12** The Applicator shall be fully responsible for adherence to all statutory regulations applicable for handling & disposal of the hazardous chemicals during the coating works and shall obtain all statutory approvals/ clearances from relevant Authorities including Pollution Control Board, as applicable for the coating plant(s).

**5.0 REQUIREMENTS FOR QUALITY**

- 5.1** The Applicator shall have established within his organization and, shall operate for the contract, a documented Quality System that ensures that the requirements of this specification are met in all respect. The Quality System shall be based upon ISO 9001/2 or equivalent.
- 5.2** The Applicator shall have established a Quality Assurance Group within its organization that shall be responsible for reviewing the Quality System and ensuring that it is implemented.
- 5.3** The Applicator shall submit the procedures that comprise the Quality System to the Company for agreement.
- 5.4** The Applicator's Quality System shall pay particular attention to the control of suppliers and sub-contractors and shall ensure that the requirements of this specification are satisfied by the suppliers and sub-contractors operating Quality system in their organization.
- 5.5** The Applicator shall, prior to the commencement of work, prepare and issue a Quality Plan for all of the activities required satisfying the requirements of this specification. The plan shall include any sub-contracted work, for which the sub-contractors Quality Plans shall be submitted. The plan shall be sufficiently detailed to indicate sequentially for each discipline the requisite quality control, inspection, testing and certification activities with reference to the relevant procedures and the acceptance standards.
- 5.6** The Applicator's Quality system and associated procedures may, with due notice, be subject to formal audits. The application of quality control by the Applicator will be monitored by the Company Representatives who will witness and accept the inspection, testing and associated work required by this specification.

**6.0 COATING CLASSIFICATION**

**6.1 General**

The three layer coating as per this specification shall belong to coating Class B of ISO 21809- 1: 2011 and shall be suitable for design temperature range of (—) 40 °C to (+) 80 °C.

**6.2 Coating thickness**

Minimum overall thickness of finished coating shall be as per Table 1 below:

**Table 1— Minimum thickness of finished coating**

Pipe Size (Specified Outside Diameter)	Minimum Coating Thickness (mm)
≤ 10 3/4" (273.1 mm)	2.5
≥12 3/4" ( 323.9 mm) to ≤ 18" (457 mm)	2.8
≥ 20" (508.0 mm) to ≥ 30" (762 mm)	3.0
≥ 32" (813.0 mm)	3.3

All coating thickness readings must meet the minimum requirements. However, localized coating thickness of less than the permissible minimum thickness can be tolerated on the condition that it does not attain a total extent of more than 5 cm 2 per meter length of coated pipe, and the actual coating thickness does not drop more than 10% below the permissible minimum coating thickness at these locations.

**7.0 MATERIALS**

**7.1** The three-layer coating system shall comprise of a powder epoxy primer, copolymeric or grafted adhesive and a high-density polyethylene (HDPE) topcoat. Coating materials shall be suitable for the service conditions and the pipe sizes involved.

**7.2 Pipe**

Details of line pipe such as specification, diameter, wall thickness, length, material, grade etc., on

**7.3 Coating Material**

**7.3.1** The coating materials i. e. epoxy powder, copolymeric or grafted adhesive and polyethylene compound shall have proven compatibility.

**7.3.2** Applicator shall choose brand of epoxy powder and adhesive as per `Annexure I' of this specification that will achieve the functional requirements and properties of coating system as specified in clause 7.3.1 and Table 5 of this specification.

**7.4 Qualification of coating materials**

**7.4.1** The coating system and materials shall be pre-qualified and approved by Company in accordance with provisions of Annexure I of this specification. Applicator shall obtain prior approval from Company for the coating system and coating materials.

**7.4.2** The coating materials manufacturer shall carry out tests for all properties specified in Table 2, Table 3 and Table 4 of this specification for each batch of epoxy, adhesive and polyethylene compound respectively. In addition, the manufacturer shall also furnish infra-red scan for each batch of epoxy powder. The manufacturer shall issue Inspection Certificate 3.1 B in accordance with EN 10204 for each batch of materials supplied to Applicator and same shall be submitted to Company for approval prior to their use.

**7.4.3 Epoxy properties**

Epoxy properties shall meet the properties listed in Table 2 below:

**Table 2 - Epoxy properties**

Sl. No.	Properties	Unit	Requirement	Test Method
<b>Raw material</b>				
1.	Density	g/l	Within $\pm 0.05$ of the manufacturer's specified nominal value	ISO 21809-1 Annex N
2.	Gel time at 205° C $\pm$ 3° C	s	Within 20% of the nominal value specified by the manufacturer	ISO 21809-1 Annex J
3.	Particle size	--	Within manufacturer's specification	ISO 21809-2 Annex A.6
4.	Moisture Content	%mass	$\leq 0.5$	ISO 21809-1 Annex K
5.	Minimum glass transition temperature ( $T_g2$ )	°C	$\geq 95$ and within manufacturer's specification	ISO 21809-1 Annex D
6.	Infrared scan	% transmittance	As per manufacturer's specification	--
<b>As-applied</b>				
7.	Hot water adhesion 24h @ 65 °C	--	Rating of 1 to 2	ISO 21809-2, Clause A.16
8.	Hot water adhesion 28d @ 65 °C	--	Rating of 1 to 3	ISO 21809-2, Clause A.16
9.	Flexibility at 0 °C	--	No cracking, tears, disbandment or delamination at 2.0° ppd length	ISO 21809-2, Clause A.13
10.	Impact resistance at 0 °C	J	$\geq 1.5$	ISO 21809-2, Clause A.14

The colour of epoxy powder shall be either green or dark red or any other colour approved by Company except grey colour.

#### 7.4.4 Adhesive material properties

Copolymeric or grafted adhesive material shall meet the properties listed in Table 3 below:

**Table 3 — Copolymeric or grafted adhesive material properties**

Sl. No.	Properties	Unit	Requirement	Test Method
<b>Raw material</b>				
1.	Density	kg/m <sup>3</sup>	≥ 930 and within manufacturer's specification	ISO 1183
2.	Melt flow rate	g/10 minutes	≥ 1.0 and within manufacturer's specification	ISO 1133
3.	Water Content	%	≤ 0.1	ISO 15512
<b>As-applied</b>				
4.	Elongation at break at 23 °C± 2 °C	%	≥ 600	ISO 527-2
5.	Tensile yield strength at 23°C ± 2 °c	MPa	≥ 8	ISO 527-2
6.	Vicat softening temperature A/50 (9.8 N)	°C	≥ 100	ISO306
7.	Flexural Modulus	MPa	≥ 450	ASTM D790

#### 7.4.5 PE (top coat) material properties

The topcoat polyethylene used shall be a black readymade compound, fully stabilized against influence of ultraviolet radiation (i.e. sunlight), oxygen in air and heat (due to environmental temperature up to + 80°C). No visible change shall occur during exposure to such environments up to at least a period of 8,500 hours. The Applicator shall submit certificate from Manufacturer in this regard.

PE material shall meet the properties listed in Table 4 below:

**Table 4 - PE (top coat) material properties**

Sl. No.	Properties	Unit	Requirement	Test Method
<b>Raw material</b>				
1.	Density	g/cm <sup>3</sup>	≥ 0.930	<b>ISO 1183</b>
2.	Melt flow rate	g/10 minutes	≥ 0.25 and within manufacturer's specification	ISO 1133

Sl. No.	Properties	Unit	Requirement	Test Method
3.	Water content	%	≤ 0.5	ISO 15512
4.	Carbon black content	%	≥ 2	ASTM D1603
5.	Melting point	°C	≥ 120	ISO 3146
<b>As-applied</b>				
6.	Hardness	Shore D	≥ 55	ISO 868
7.	Elongation at break at 23°C ± 2 °C	%	≥ 600	ISO 527
8.	Tensile strength at 23°C ± 2 °C	MPa	≥ 17	ISO 527
9.	Vicat softening temperature A/50 (9.8 N)	°C	≥ 110	ISO 306
10.	Environmental Stress Cracking Resistance (ESCR) (50°C, F50, cond.B)	<i>h</i>	≥ 300	ASTMD1693
11.	Oxidative induction time(intercept in the tangent method) in oxygen at 220°C, Aluminum pan, no screen	minute	≥ 10	ISO 11357
12.	UV resistance and thermalageing	%	ΔMFR≤35	ISO 21809-1 AnnexG
13.	Indentation (mass 2.5 kg)	mm	≤0.2@20°C ≤0.4@80°C	ISO 21809-1 AnnexF
14.	Impact resistance	J/mm	≥ 7	ISO 21809-1 AnnexE
15.	Volume Resistivity @23°C±2 °C	Ohm-cm	≥10 <sup>16</sup>	ASTM D257
16.	Dielectric withstand, 1000 Volts/second rise @23°C±2°C	V/mm	≥ 30,000	ASTMD149

- 7.4.6 In addition to manufacturer's Certificate, the Applicator shall draw samples from each batch of epoxy, adhesive and polyethylene in the presence of Company Representative and test for the following properties at the coating yard at least one week prior to its use, to establish compliance with the manufacturer's Test Certificates.
- a) Epoxy Powder
    - i. Gel Time
    - ii. Cure time
    - iii. Moisture content
    - iv. Thermal Characteristics ( $T_{g1}$ ,  $T_{g2}$ ,  $\Delta H$ )
  - b) Adhesive
    - i. Density
    - ii. Melt flow rate
    - iii. Vicat softening temperature
    - iv. Water content
  - c) **Polyethylene**
    - i. Melt flow rate (MFR)
    - ii. Density
    - iii. Water content
    - iv. Thermal stabilization (as per ASTM D3895)

In case of failure of any of the above tests in a batch, that batch of material shall be tested for all other tests required as per Table 2, Table 3 and Table 4 of this specification including the tests which failed. If all tests pass, the batch shall be accepted for coating. If any of the tests fail, entire batch of material shall be rejected and shall not be used for the coating.

## 7.5 Storage and handling of coating materials

- 7.5.1 All materials to be used shall be supplied in sealed, damage free containers and shall be suitably marked with the following minimum information:
- a) Name of the manufacturer
  - b) Type of material/ product description
  - c) Mass/ Quantity of material
  - d) Batch number
  - e) Location of manufacture
  - f) Date of manufacture
  - g) Manufacturing identification number
  - h) Temperature requirements for transportation and storage
  - i) Shelf life or 'use by' date (DD/MM/YYYY)
  - j) Qualified minimum flexibility test temperature

k) Safety Data Sheets (to be included with delivery)

7.5.2 All materials noted to be without above identification shall be deemed suspect and shall be rejected by Company. Such materials shall not be used for coating and shall be removed from site/ store and replaced by Applicator at his own expense.

7.5.3 Applicator shall ensure that all coating materials are properly stored in accordance with the Manufacturer's recommendation at all times, to prevent damage and deterioration in quality prior to use.

7.5.4 Applicator shall be required to use all materials on a date received rotation basis, i.e. first-in first used basis.

## 8.0 COATING SYSTEM QUALIFICATION

### 8.1 General

Properties of coating system and as-applied coating material shall comply the requirements indicated in Table 5 of this specification. In case the coating / material properties are tested as per test methods/ standards other than specified herein below, the same may be accepted provided the test procedures and test conditions are same or more stringent than the specified.

### 8.2 Application procedure specification (APS)

8.2.1 Upon award of the CONTRACT, the Applicator shall submit within two (2) weeks, for Company approval, a detailed report in the form of bound manual outlining, but not limited to, the following:

- a. Details of plant(s), location(s), layout, capacity and production rate(s).
- b. Details of process control and inspection equipment required for the coating process such as temperature control, thickness control, holiday testers, etc.
- c. Details of the equipment available to carry out the coating works including surface preparation, epoxy powder application and its recycling system, adhesive & polyethylene extrusion, moisture control facilities available for coating materials.
- d. Facilities in the yard for unloading, handling, transport, production, storage, stockpiling, loading of bare and coated pipes and warehouses for storage of other coating materials.
- e. Plant Organization Chart and availability of manpower including coating specialist
- f. Details of utilities/facilities such as water, power, fuel, access roads and communication etc.

After Company has given approval; no change in plant set-up shall be made. However, unavoidable changes shall be executed only after obtaining written approval from Company.

8.2.2 At least four (4) weeks prior to the commencement of production coating, a detailed procedure of the Applicator's methods, material proposed, etc., shall be formulated by the Applicator and submitted for Company approval in the form of a bound manual. The procedure shall include, but not limited to, the following information and proposals:

- a. Procedure for pipe inspection at the time of bare pipe receipt.
- b. Procedure for pipe tracking
- c. Procedure for steel surface preparation, including preheating, removal of steel defects, method of pipe cleaning, dust removal, abrasive blast cleaning and surface profile; methods of measurements and consumables.
- d. Procedure for pipe heating, temperatures and control prior to epoxy application.



- e. Complete details of raw materials for coating, repair and blasting operation including current data sheets showing values for all the properties specified together with quality control and application procedure recommendations from manufacturer(s).
- f. Procedure for application of FBE powder, adhesive and polyethylene, including characteristics, temperature, line speed, application window, curing time, gel time etc.
- g. Quenching and cooling procedure including time and temperature.
- h. Procedure for continuous temperature monitoring at various stages of coating.
- i. Procedure for preparation of coating cutback area.
- j. Quality Assurance System, Quality Plan, Inspection and Test Plan and reporting formats, including instrument and equipment types, makes and uses, etc
- k. Detailed method of repair of coating defects duly classified depending upon nature and magnitude of defects and repair thereof including coating stripping technique.
- l. Details of instrument and equipment calibration methods including relevant standards and examples of calibration certificates.
- m. Procedure for cleaning of all application equipment.
- n. Complete details and inventory of laboratory and equipment for procedure qualification and regular production.
- o. Coated pipe handling, stock piling and/or loading procedures including protection of pipe ends.
- p. Sample of recording and reporting formats (Daily log format), including laboratory reports, certificates and requirement as per clause 14.0 of this specification.
- q. Complete details of test certificates for raw materials including test methods and standards used.
- r. Test certificates from PE compound manufacturer for tests for thermal aging, volume resistivity and aging under exposure to light. These test certificates shall not be older than three years.
- s. Health, Safety and Environment Plans.
- t. Storage details of coating materials and chemicals.

### 8.3 Procedure Qualification Tests

- 8.3.1 Prior to start of production, the Applicator shall, at his expense, carry out a coating Procedure Qualification Tests (PQT), for each pipe diameter on max. wall thickness, for each type of pipe, for each coating material combination, and for each plant, to prove that his plant, materials, and coating procedures result in a quality of end product conforming to the properties stated in Table 5 of this specification, relevant standards, specifications and material manufacturer's recommendations. Applicator shall give seven (7) working days' notice to witness all procedures and tests.
- 8.3.2 Procedure Qualification Tests (PQT) shall be carried out only after obtaining written approval of the above procedure from Company. No change in the procedure shall be made after the Company has given approval. However, unavoidable changes shall be executed only after obtaining written approval from Company.
- 8.3.3 A batch representing a normal production run, typically fifteen (15) pipes, shall be coated in accordance with the approved coating procedure and the coating operations witnessed by Company Representative. Out of these pipes, at least one pipe shall be coated partly with epoxy and partly with both epoxy and adhesive layers.

- 8.3.4 At least five (5) test pipes shall be selected by Company Representative for coating procedure approval tests and shall be subjected to procedure qualification testing as described hereinafter. Company Representative shall witness all tests. Out of five (5) test pipes, one (1) pipe partly coated with epoxy and partly coated with both epoxy and adhesive layers shall be included. Remaining four (4) test pipes shall have all three layers.
- 8.3.5 During PQT, the Applicator shall qualify various procedures forming a part of coating operations as detailed subsequently.
- 8.3.6 After completion of the qualification tests and inspection as per clause 7.4.6 and Table 5 of this specification, the Applicator shall prepare and issue to Company for approval a detailed report of the tests and inspection including test reports/certificates of all materials and coatings tested. Only upon written approval from Company, Applicator shall commence production coating.
- 8.3.7 On successful completion of PQT, coating of all five (5) test pipes shall be removed and completely recycled as per the approved coating procedure specification, at Applicator's expense. Remaining pipes will be accepted by Company provided they meet the requirements of this specification and need not be stripped and re-cycled.
- 8.3.8 The Applicator shall re-establish the requirements of qualification and in a manner as stated before or to the extent considered necessary by Company, in the event of, but not limited to, the following:
- Every time there is a change in the previously qualified procedure.
  - Every time there is a change in the manufacturer and change in formulation of any of the raw materials and change in location of raw material manufacture.
  - Every time the coating yard is shifted from one location to the other or every time the critical coating equipment (induction heater, epoxy spray system, extruder etc.) are shifted.
  - Any change in line speed during coating application.
  - Any time when in Company's opinion the properties are deemed to be suspect during regular production tests.
- 8.3.9 Company reserves the right to conduct any or all tests required for qualification through an independent laboratory or agency at the cost of Applicator when in Company's opinion, the results are deemed suspect. Company's decision shall be final.

#### **8.4 Properties of As-applied Coating System**

- 8.4.1 All pipes shall be subject to the following inspections:
- a. Surface cleanliness, surface roughness measurements and dust control immediately after second abrasive blast cleaning and salt test.
  - b. Visual inspection of finished coating, cut back dimension, internal/external cleanliness, end sealing and bevel inspection.

Acceptance criteria for all inspection and testing shall be as specified in this specification.

- 8.4.2 Properties of as-applied coating system shall meeting the minimum requirements as per Table 5 below:

**Table 5 — Requirements for plant applied coating  
(PQT and Production)**

Sl. No.	Properties	Acceptance Criteria	Test Method	Inspection Frequency	
				During PQT	During Production
<b>A. Epoxy Layer</b>					
1.	Pipe feed rate	Asper APS	As per APS	Each pipe	Continuous monitoring a)
2.	Air pressure in epoxy spray guns	Asper APS	As per clause 9.3.3.7 of this specification	Each pipe	Continuous monitoring & recording
3.	Induction coil setting	Asper APS	Asper APS and clause 9.3.2.2 of this specification	Each pipe	Continuous monitoring a)
4.	Pipe temperature	As per clause 9.3.2.3 of this specification	As per clause 9.3.2.4 of this specification	Continuous monitoring & recording	Continuous monitoring and recording
5.	Minimum epoxy layer thickness (OFT)	≥ 0.200mm	ISO 2808 e)	One pipe <sup>d)</sup>	l/shift <sup>f)</sup>
6.	Degree of cure - Percentage cure, ΔH <sub>1</sub> - Δ.T <sub>g</sub>	95% ≤ 5°C	ISO 21809-1 Annex D and clause 10.9 of this spec.	4 samples x 1 pipe <sup>g),d)</sup>	l/shift <sup>b)</sup>
7.	Holiday detection (test voltage set to exceed SV per μm of epoxy thickness)	No holidays	ISO 21809-1, Annex B	Each piped)	Not required
8.	Dry adhesion	Rating 1 or2	ISO 21809-2 ClauseA.4 & clause 10.10 of this spec.	One pipe	l/shift
9.	Cross-section porosity	≤ compared with Fig. All of ISO 21809-2	ISO 21809-2 Clause A.12	Each pipe <sup>d)</sup>	Not required
10.	Interface porosity	≤ compared with Fig. A.12 of ISO 21809-2	ISO 21809-2 ClauseA.12	Each pipe <sup>d)</sup>	Not required
11.	Hot water adhesion 24h @ 65 °C	Rating of 1 to 3	ISO 21809- 2, Clause A.16	One pipe	Not required
12.	Flexibility at 0 °C	No cracking, tears, disbondment & delamination at 2.0° ppd length	ISO 21809-2, Clause A.13	One pipe <sup>d)</sup>	Not required
<b>B. Adhesive Layer</b>					

Sl. No.	Properties	Acceptance Criteria	Test Method	Inspection Frequency	
				During PQT	During Production
13.	Minimum thickness	≥ 0.200 mm	ISO 2808 <sup>e)</sup>	One pipe <sup>d)</sup>	1/shift <sup>f)</sup>
14.	Extrusion temperature of adhesive	As per APS	Asper APS & clause 9.3.3.8 of this spec.	Continuous monitoring & recording	Continuous monitoring & recording
C.	<b>PE layer and all three layer</b>				
15.	PE extrusion temperature	Asper APS	Asper APS	Each pipe	Continuous monitoring & recording
16.	Water quenching	Asper APS	Asper APS	Each pipe	Continuous monitoring
17.	Visual inspection	As per clause 10.2 of this specification	Visual	Each pipe 100% surface area	Each pipe 100% surface area
18.	Holiday detection (test voltage shall be min. 25 kV & travel speed shall not exceed 300 mm/s)	As per clause 10.4.2 of this specification	As per ISO 21809-1, Annex-B and clause 10.4.1 of this spec.	Each pipe 100% surface area	Each pipe 100% surface area
19.	Coating thickness	Table 1 of this specification	ISO2808 & clause 10.3 of this spec.	Each pipe	Each pipe <sup>h)</sup>
20.	Tensile strength @ 23°C±2°C	≥17 MPa	ISO 527	One pipe	Not required
21.	Air entrapment test	≤ 10% & as per clause 10.8 of this specification	As per clause 10.8 of this specification	5 pipes x 1 sample from body & 1 sample from weld (if applicable)	1 sample from body & 1 sample from weld (if applicable)/ shift
22.	Bond Strength (Peel Strength) ■ @23°C±2°C (No peeling of FBE layer)	≥15 N/mm	ISO 21809-1 Annex C, (clause C.2 or C.5 hanging mass) and clause 10.5 of this spec.	5 pipes x 3 tests (@ both ends & middle) <sup>d)</sup>	2 h for pipe ends (cutback portion) & 4 h for middle of pipe
	■ @80°C±2°C (No peeling of FBE layer)	≥3 N/mm		5 pipes X 3 tests (@ both ends & middle) <sup>d)</sup>	2 h for pipe ends (cutback portion) & 4 h for middle of pipe
23.	Coating Resistivity <sup>k)</sup>	10 <sup>8</sup> Ω-m <sup>2</sup>	Annex J of DIN 30670	One pipe	Not required

Sl. No.	Properties	Acceptance Criteria	Test Method	Inspection Frequency	
				During PQT	During Production
24.	Impact resistance (min. of 30 impacts onbody located equi-Distance along the length.No breakdown allowed when tested at 25 kV)	≥7 J/mm of coating thickness	ISO 21809-1 Annex-E and clause 10.6 ofthis spec.	3 pipes	2 pipes / shift <sup>i)</sup>
25.	Indentation resistance		ISO21809-I Annex F and clause 10.6 ofthis spec.		
	• @23°C±2°C	≤ 0.2mm		2 samples x 5 pipes <sup>m)</sup>	2 pipes/ shift <sup>i)</sup>
	• @80°C±2°C	≤ 0.3 mm		2 samples x 5 pipes m)	2 pipes/ shift <sup>i)</sup>
26.	Elongation at break	≥ 400%	ISO 527-3 & clause 10.12 of this spec.	6 samples x 3 pipes	Once per PE batch
27.	Cathodic disbondment test	(Average disbandment radius)	ISO 21809-1 Annex Hand clause 10.11 of this specification		
	• 65 °C/ 24 h; - 3.5 V	≤7mm		One pipe	Once/ day
	• 23 °C/28 d;-1.5 V	≤7mm		One pipe <sup>1)</sup>	Not required
	• 80 °C/ 28 d; -1.5 V	≤ 15 mm		One pipe <sup>1)</sup>	Not required
28.	Hot Water Immersiontest	Avg. ≤ 2mm& max. ≤ 3 mm, 48 hours	ISO 21809-1 Annex Mand clause 10.13 of this spec.	One pipe	Once/ day
29.	Flexibility	No cracking at an angle of 2.0° ppd length	ISO 21809-1 Annex I	One pipe	Not required
30.	Hardness	≥55 ShoreD	ISO 868	One pipe	Not required
31.	Residual magnetism of line pipe	Avg. of the four readings ≤ 2.0 mT (20 gauss) & no single reading ≥ 2.5 mT (25 gauss)	Hall - effect gaussmeter	One pipe x 4 readings approx. 90° apart around the circumference of both ends of the pipe	l/shift
<p><b>Notes:</b></p> <p>a) Parameter shall be recorded at least once per shift.</p> <p>b) Lead pipe shall be subjected to this test and thereafter pipes shall be selected randomly by Company Representative during the middle of a shift. Suitable provisions/ arrangements as per the instructions of Company Representative shall be made by the Applicator for this purpose.</p>					

Sl. No.	Properties	Acceptance Criteria	Test Method	Inspection Frequency	
				During PQT	During Production
	c) Shift duration shall be maximum 12 hours. d) The value obtained from the test shall meet the specified requirement. None of the test value shall fail. e) Thickness shall be checked at every one meter spacing at 3, 6, 9 and 12 o'clock positions. f) Thickness of epoxy and adhesive shall be measured at the beginning of each shift and whenever the plant re-starts after any stoppage for compliance. Coating of epoxy and adhesive on portion of pipe required for this purpose, stripping and recoating of such partly coated pipes shall be at Applicator's expense. g) Epoxy film samples (minimum 4 no.) shall be scratched from the coated pipe. Care shall be taken to remove the samples of full film thickness avoiding inclusion of steel debris. h) The frequency may be reduced "Once in 10 pipes" depending upon consistency of results, at the sole discretion of Company Representative. Results of all measurements shall be recorded. i) Test shall be carried out at every change in batch of PE. Frequency of test may be reduced to one pipe per 2 weeks depending upon the consistently acceptable results at the sole discretion of Company's Representative. j) Test shall be carried out at every change in batch of PE. Frequency of test may be reduced to one test each on 2 coated pipes per week at random, after 1 week of consistently acceptable results. k) Test carried out in an independent laboratory of national/international recognition on PE topcoat is also acceptable. l) In case of PQT necessitated for different pipe size with same coating material combination, 24 hours test shall only be conducted and 28 days test is not mandatory. m) If any one of these samples fails to satisfy the specified requirements, then the test shall be repeated on four more samples. In this case, none of the samples shall fail.				

## 8.5 Qualification of Procedures

### 8.5.1 Epoxy Powder Application & Recycling

During pre-qualification, air pressure in the epoxy spray guns, satisfactory functioning of monitoring system, line speed v/s coating thickness, etc. shall be established. Dew point of air used to supply the fluidized bed, epoxy spray system and epoxy recycling system shall be recorded during the PQT.

Also, the Applicator shall remove samples of reclaimed powder from the reclamation system. These samples of reclaimed powder shall be subject to a detailed visual examination, thermal analysis and moisture content tests. The properties of the reclaimed powder shall be within the range specified by the Manufacturer of epoxy powder. In case the properties of the reclaimed powder are out of the range specified by the Manufacturer, Applicator shall not use the reclaimed powder during the regular production. The proportion of the reclaimed powder in the working mix shall not exceed 10% at any time.

### 8.5.2 Pipe Pre-heating

The Applicator shall establish the temperature variation due to in-coming pipe temperature, line speed variation, wall thickness variation, emissivity, interruptions, etc. and document the same during the PQT stage. During PQT, proper functioning of pipe temperature monitoring and recording system including alarm/hooter shall be demonstrated to the Company Representative.

### 8.5.3 Surface Preparation

The procedure to clean and prepare the pipe surface shall be in accordance with the requirements of this specification. The ratio of shot to grit shall be established during procedure qualification testing, such that the resultant surface profile is not dished and rounded. The qualification shall be performed through a visual inspection, measurement of roughness and check of the presence of dust on the abrasive blast cleaned pipe surface.

#### **8.5.4 Coating Application**

The Company Representative will check the correctness of each coating application operation, values of the main parameters of each operation, pre-heating pipe surface temperature prior to epoxy powder application temperature, line speed, fusion bonded epoxy curing time, temperature and flow rate of copolymeric or grafted adhesive and polyethylene, etc. and the same shall be recorded. These values shall be complied with during regular production.

### **9.0 APPLICATION OF COATING**

#### **9.1 General**

Unless specified otherwise, the pipes shall be supplied free from mill applied oils but may be subject to contamination occurring during transit.

#### **9.2 Pipe Surface Preparation**

##### **9.2.1 Initial evaluation and surface preparation**

9.2.1.1 Applicator shall visually examine the pipes as per Table 6 of this specification and shall ensure that all defects and irregularities (i.e. slivers and scratches), flats and other damages have been repaired or removed. Grinding of steel defects shall not reduce the wall thickness of the pipes below the specified wall thickness of the pipe.

9.2.1.2 Any oil, grease, salt or other contaminants detrimental to the formation of a good coating bond or coating quality shall be removed prior to coating application. Contaminants may be removed by the use of non-oily solvents. Gasoline or kerosene shall not be used for this purpose. Visible oil and grease spots shall be removed by solvent wiping in accordance with SSPC-SP 1. Steel surface shall be allowed to dry before abrasive blast cleaning.

9.2.1.3 The Applicator shall also remove marking stickers, if any, present within the pipe. Record shall be kept of such marking on the stickers to ensure traceability of pipe after coating.

##### **9.2.2 Abrasive blast cleaning**

9.2.2.1 All pipes shall be preheated to a temperature of 65°C to 85°C prior to abrasive blast cleaning. The external surface of the pipes shall be cleaned using two (2) no. dry abrasive blast cleaning units to achieve the specified surface cleanliness and profile as per Table 6 of this specification. 9.2.2.2 The abrasive blast cleaning units shall have an effective dust collection system to ensure total removal of dust generated during blast cleaning from the pipe surface. During abrasive blast cleaning, the metallic abrasive shall be continuously sieved to remove "fines" and "contaminants" and the quality checked at every four (4) hours. Abrasives used for blast cleaning shall comply ISO-11124 (all parts) and Table 6 of this specification. Silica sand or copper slag shall not be used as abrasive material.

9.2.2.3 Abrasive blast cleaning carried out shall be such that the resultant surface profile is not dished and rounded when viewed with 30X magnification. The standard of finish for cleaned pipe shall conform to near white metal finish as per Table 6 of this specification. This shall be measured by a suitable instrument such as surface profile depth gauge.

In addition the pipe surface after blast cleaning shall be checked for the degree of cleanliness, degree



of dust and shape of profile as per Table 6 of this specification. Tape used for assessment of degree of dust shall comply ISO 8502-3. Pressure shall be exerted on the applied tape using a 4 kg roller, prior to peeling-off to assess the degree of dust.

- 9.2.2.4 The blast cleaned surface shall not be contaminated with dirt, dust, metal particles, oil, water or any other foreign material, nor shall the surface or its anchor pattern be scarred or burnished. All blast cleaned pipe surface shall be kept in dust free enclosure prior to coating.
- 9.2.2.5 After blast cleaning, all surfaces shall be thoroughly inspected under adequate lighting to determine anchor pattern, quality of blasting and identify any surface defects prior to coating application. All surface defects such as slivers, scab, burns, laminations, welds spatters, gouges, scores, indentations, slugs or any other defects considered injurious to the coating integrity made visible during blast cleaning shall be reported to the Company Representative and on permission from Company Representative such defects shall be removed by filing or grinding. After any grinding or mechanical repairs, the remaining wall thickness shall be checked and compared with specified thickness. Any pipes having thickness less than specified wall thickness shall be kept aside and disposed-off as per the instructions of Company Representative.
- 9.2.2.6 The method employed to remove surface defects shall not burnish or destroy the anchor pattern or contaminate the surface. Pneumatic tools shall not be used unless they are fitted with effective air/oil and water traps. Wherever burnishing results in destruction of anchor pattern, the anchor pattern shall be restored by suitable means. Pipes having damages repaired by grinding and ground areas more than 50 mm in diameter shall be re-blasted.
- 9.2.2.7 Suitable plugs shall be provided at both pipe ends to prevent entry of any shot/ grit into the pipe during blast cleaning operations. These plugs shall be removed after blast cleaning. Alternatively the Applicator may link the pipes suitably together to prevent the entry of any short/grit into the pipe.
- 9.2.2.8 At no time shall the blast cleaning be performed when the relative humidity exceeds 85%. The Applicator shall measure the ambient conditions at regular intervals during blast cleaning and coating operations and keep records of prevailing temperature, humidity and dew point as per Table 6 of this specification.
- 9.2.2.9 The total allowable elapsed time between completion of the blasting operations and commencement of the pre-coating and heating operations shall be such that no detectable oxidation of the surface occurs. Relative humidity readings shall be recorded every half an hour during the blasting operations in the immediate vicinity of the operations. The maximum elapsed time shall not exceed the duration given below:

Relative Humidity %	Maximum elapsed time
> 80	2 h
70 to 80	3 h
<70	4h
<b>Note:</b>	
a) Any pipe not processed within the above time-humidity requirement shall be completely re-blasted. Any pipe showing flash rusting shall be re-blasted even if the above conditions have not been exceeded.	

- 9.2.2.10 All pipes shall be visually examined for presence of any shot/ grit/ loose material left inside the pipe during blast cleaning. Suitable mechanical means (stiff brush) shall be employed to remove the same before the pipes are processed further. In addition, inside surface of the pipe shall also be visually inspected for presence of any foreign material or shots and grit (free or embedded/ sticking to pipe inside surface). The pipe inside surface shall be examined using sharp floodlight focused at the middle of the pipe at one end while inspection is carried out visually from other end. Any foreign material or



shots/grit present in the pipe shall be completely removed by mechanical brush, high pressure air jets, by tilting of pipe etc.

- 9.2.2.11 Upon Completion of the blasting operations, the quality control supervisor shall accept the pipe for further processing or return for re-blasting after removal of defects/ imperfections. In case imperfections are considered detrimental to the coating quality, the same shall be reported to Company's Representative for final decision on rejection or re-blasting/ removal of defects. Re-blasting/ removal of defects or returning pipe to the yard shall be at the Applicator's cost. Company's Representative, in additions, reserves the right to initiate any of the above actions during periodic inspections for oil, dust, salt, imperfections, surface defects, lack of white metal finish, etc.

In order to ensure that pipe with defects are not processed further, provisions shall be available to lift the pipe from inspection stand.

- 9.2.2.12 Pipe handling between abrasive blasting and pipe coating shall not damage the surface profile achieved during blasting. Any pipe affected by the damage to the surface exceeding 200 mm<sup>2</sup> in area and/ or having contamination of steel surface shall be rejected and sent fore-blasting.

**9.2.3 Surface dust contamination**

- 9.2.3.1 Any dust or loose residues that have been accumulated during blasting and/or during filing/ grinding operations shall be removed by vacuum cleaning. The dust level shall be measured and acceptance requirements shall be in accordance with Table 6 of this specification.

- 9.2.3.2 If dust contamination of surface occurs, the quality of blast cleaning method and process shall be examined. If the surface roughness is outside the specified limit, the blast cleaning material shall be checked and replaced.

**9.2.4 Surface cleanliness and salt contamination tests**

- 9.2.4.1 All pipes shall be tested for salt contamination after blast cleaning as per Table 6 of this specification. An approved salt meter (SCM 400 or equivalent) shall be used to carry out salt tests and shall be calibrated in accordance with the equipment manufacturer's recommendations.

- 9.2.4.2 Any pipe having salt contamination exceeding the acceptable limits as per Table 6 of this specification shall be either re-blasted or washed by de-ionized water and then rechecked for salt contamination. In case salt level less than acceptable limit as per Table 6 of this specification is consistently achieved, the frequency of salt contamination testing may be relaxed to at least one pipe per hour at the sole discretion of the Company Representative.

**Table 6 — Requirements for inspection of surface preparation of pipe**

Sl. No.	Properties	Test Method	Requirement	Frequency	
				DuringPQT	During Production
1.	Surface condition of pipe before blasting	Visual Inspection	Free of contaminations and surface defects	Each pipe	Each pipe
2.	Relative humidity	Measurement/ as required	Record (relative humidity shall be <80%)	Every½ h	Every ½h

Sl. No.	Properties	Test Method	Requirement	Frequency	
				DuringPQT	During Production
3.	Pipe temperature before blasting	Thermocouple	min. 3°C above dew point	Each pipe	Every 1 h
4.	Water soluble contamination abrasive	ASTMD4940	Conductivity $\leq 60\mu S/cm$	Once	1/shift
5.	Soluble salt after blasting	Conductive measurement ISO 8502-9	Salt (Chloride) content as (NaCl) max. 20 mg/m <sup>2</sup>	Each pipe	Each pipe
6.	Size, shape and properties of virgin abrasive	Visual + Certification as per ISO 11124-3	Conformity to certificate and compliance with manufacturing/working procedure	Every batch	Every batch
7.	Surface roughness of blasted surface	ISO 8503-4	Rz/Rys: 75 $\mu m$ to 100 $\mu m$	Each pipe	Every 1 h
8.	Visual inspection of blasted surface	ISO 8501-1	grade Sa2½	Each pipe	Each pipe
9.	Presence of dust after dust removal	ISO 8502-3	max. class 2 (for both size and quantity)	Each pipe	Every 1 h
10.	Visual inspection of pipes prior to introduction to coating line	Visual	No rust	Each pipe (100% surface area)	Each pipe (100% surface area)
11.	Preheating temperature before coating	Pyrometer	Compliance to <b>APS</b>	Each pipe	Each pipe

### 9.3 Coating application and curing temperature

#### 9.3.1 General

The external surface of the cleaned pipe conforming to clause 9.2 of this specification shall be immediately coated with 3-layer extruded polyethylene coating in accordance with the procedures approved by Company, relevant standards and this specification.

#### 9.3.2 Pipe heating and curing

9.3.2.1 Immediately prior to heating of pipe, all dust and grit shall be removed from inside of the pipe by a combination of air blast, brushing and vacuum cleaning. Suitable arrangement shall be made to protect the bevel ends from getting damaged during the coating operation.

9.3.2.2 Induction heater shall be used for heating the pipe. The method shall be capable of maintaining uniform temperature along the total length of the pipe, and shall be such that it shall not contaminate the surface to be coated. Appropriate frequency shall be used to ensure 'deep heating' and intense skin heating is avoided. This shall be demonstrated on bare pipes prior to start of PQT.

9.3.2.3 External surface of the pipe shall be heated to about 190°C or within a temperature range (min. to max.) as recommended by the epoxy powder manufacturer. However, application and curing temperature shall not exceed 250°C in any case. Required pipe temperature shall be maintained as it enters the coating chamber.

Any deviation from the application temperature range recommended by manufacturer shall be rectified. If immediate rectification is not feasible, the production shall be stopped until cause of deviation has been removed. Any pipe coated during the period of temperature deviation shall be identified by marking and rejected. Such rejected pipes shall be stripped, re-cleaned and recoated.

9.3.2.4 Temperature of the pipe surface shall be continuously monitored & recorded by using suitable instruments such as infrared sensors, contact thermometers, thermocouples etc. The recording method shall allow to correlate each line pipe. The monitoring instrument shall be able to raise an alarm/ activate audio system (hooter) in the event of tripping of induction heater or in the event of pipe temperature being outside the range recommended by the manufacturer.

Temperature measuring & monitoring equipment shall be calibrated twice every shift and/or as per Company Representative's instruction.

9.3.2.5 Applicator shall ensure that pipe surface emissivity variations are minimized during pipe heating. To avoid significant variance, more than once blasted pipes should be coated at the same time and not mixed with pipes blasted only once.

### 9.3.3 Pipe Coating Application

9.3.3.1 Coating materials shall be inspected in accordance with the manufacturer's recommendation prior to coating application and it shall be ensured that the materials are moisture free. In case the relative humidity exceeds 80%, the adhesive and polyethylene material shall be dried using hot dry air as per the directions of Company Representative.

9.3.3.2 Only those coating materials which are pre-qualified and approved by Company in accordance with provisions of Annexure I of this specification and qualified in accordance with the requirements of clause 7.4 i.e. Table 2, Table 3 and Table 4 of this specification shall be utilized for coating. All coating application processes shall be carried out as per manufacturer's recommendations and procedure qualification tests (PQT) as per clause 8.3 and Table 5 of this specification.

9.3.3.3 Subsequent to pipe heating, coating consisting of following layers shall be applied onto the pipe.

- i. Electrostatic application of epoxy powder of minimum dry film thickness as per Table 5 of this specification, unless otherwise specified. The maximum thickness shall not exceed the epoxy thickness specified by epoxy powder manufacturer.
- ii. Copolymeric or grafted adhesive application by extrusion of minimum thickness as per Table 5 of this specification.
- iii. Polyethylene application by extrusion.

Minimum overall thickness of finished coating shall be as per Table 1 of this specification.

9.3.3.4 The coated pipe shall be subsequently quenched and cooled in water for a period that shall sufficiently lower the temperature of pipe coating, atleast upto 80°C, to permit handling and inspection.



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- 9.3.3.5 Prior to starting the application of fusion bonded epoxy powder, the recovery system shall be thoroughly cleaned to remove any unused powder remaining from a previous line pipe coating application. The use of recycled powder shall be permitted subject to:
- a) Satisfactory qualification of the reclaimed system during PQT stage.
  - b) The proportion of the reclaimed powder in the working mix does not exceed 10% at any one time.
  - c) The quality of the recycled powder being routinely checked during production, at a minimum frequency of once per shift and consistently meets the requirements stated at clause 7.4.3 and Table 2 of this specification.
- 9.3.3.6 Dry air, free of oil and moisture shall be used in the coating chamber and spraying system and filters, dehumidifier/dryer as required along with control & monitoring system shall be provided for this purpose. Dew point of air used to supply the fluidized bed, epoxy spray system and epoxy recycling system shall be at least (-)40°C and this shall be shall be monitored during the regular production.
- 9.3.3.7 Air pressure in the epoxy spray guns shall be controlled, continuously monitored and recorded by using suitable instruments. The air pressure shall be controlled within the limits established during coating procedure qualification. The monitoring system shall be able capable of raising an alarm/ activate audio system (hooter) in the event of change in air pressure beyond the set limits. Any deviation from the pre-set limits shall be rectified. If immediate rectification is not feasible, the production shall be stopped until cause of deviation has been removed. Any pipe coated during the duration of air pressure deviation shall be identified by suitable marking and rejected. Such rejected pipes shall be stripped and recoated.
- 9.3.3.8 Extruded adhesive layer shall be applied before gel time of the epoxy coating has elapsed and within the window recommended by the manufacturer. The Applicator shall establish, to the satisfaction of the Company Representative, that the adhesive is applied within the gel time window of epoxy and at the temperature recommended by the adhesive manufacturer. The Applicator shall state the minimum and maximum time interval between epoxy and adhesive application at the proposed pre-heat temperature and line speed.
- 9.3.3.9 Extruded polyethylene layer shall be applied over the adhesive layer within the time limit established during PQT stage and within the time/ temperature range recommended by the manufacturer. The extrusion temperatures of the adhesive and polyethylene shall be continuously recorded. The monitoring instruments shall be independent of the temperature control equipment. The instruments shall be calibrated prior to start of each shift.
- 9.3.3.10 Applicator shall ensure that there is no entrapment of air or void formation along the seam weld (where applicable) during application of coating. Air entrapment below the coating and also along the coating overlap shall be prevented by forcing the coating on to the pipe using high pressure roller of suitable design during coating application. In case it is not adequately achieved, Applicator shall supplement by other methods to avoid air entrapment. The methods used shall be witnessed and approved by Company.
- 9.3.3.11 Resultant coating shall have a uniform gloss and appearance and shall be free from air bubbles, wrinkles, holidays, irregularities, discontinuities, separation between layers of polyethylene & adhesive, etc.
- 9.3.3.12 **Coating cutback**
- Coating and/or adhesive shall terminate 120 mm (+) 20/ (-) 0 mm from pipe ends. The adhesive shall seal the ends of applied coating. Applicator shall adopt mechanical brushing for termination of the coating at pipe ends. Edge of the coating shall be shaped to form a bevel angle of 30° to 45°. Wherever

specified the cut back shall be 150mm (+) 20/ (-) 0 to facilitate automatic welding.

- 9.3.3.13 Failure to comply with any of the above applicable requirement and of the approved procedure shall be cause for the rejection of the coating and such coating shall be removed in a manner approved by Company at Applicator's expense.

## 10.0 INSPECTION AND TESTING

### 10.1 General

The Applicator shall establish and maintain such quality assurance system as are necessary to ensure that goods or services supplied comply in all respects with the requirements of this specification. The minimum inspection and testing to be performed shall be as indicated subsequently herein.

### 10.2 Visual Inspection

Immediately following the coating, each coated pipe shall be visually checked for imperfections and irregularities of the coating. The coating shall be of natural colour and gloss, smooth and uniform and shall be blemish free with no dust or other particulate inclusions. The coating shall not show any defects such as blisters, pinholes, scratches, wrinkles, engravings, cuts, swellings, disbonded zones, air inclusions, tears, voids or any other irregularities. Special attention shall be paid to the areas adjacent to the longitudinal weld (if applicable), adjacent to the cut-back at each end of pipe and within the body of the pipe.

In addition inside surface of the pipe shall also be visually inspected for presence of any foreign material or shots and grit (free or embedded/sticking to pipe inside surface). The pipe inside surface shall be examined using sharp floodlight focused at the middle of the pipe at one end while inspection is carried out visually from other end.

### 10.3 Coating Thickness

- 10.3.1 Coating thickness shall be checked by taking at least 10 measurements at locations uniformly distributed over the length and periphery of each pipe. In case of welded pipes, five of these readings shall be made at apex of the weld seam, uniformly distributed over the length of the coated pipe.
- 10.3.2 Coated pipes not meeting the requirements shall be rejected. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at Applicator's expense.

### 10.4 Holiday Detection

- 10.4.1 The holiday detector shall be a low pulse D.C. full circle electronic detector with audible alarm and precise voltage control complying with DIN VDE 0433 Part 2. Applicator shall calibrate the holiday detector at least once every 4 hours of production. Applicator shall have necessary instruments or devices for calibrating the holiday detector.
- 10.4.2 Any pipe coating shall be rejected if more than one (1) holiday & area more than 100 cm<sup>2</sup> in size are detected in its length attributable to coating process.
- 10.4.3 Holidays, which are lesser in size than those mentioned in 10.4.2 above, shall be repaired in accordance with an approved procedure and shall be at Applicator's expense.

### 10.5 Bond Strength (Peel Test)

- 10.5.1 Applicator shall carryout bond strength test for applied coating as per Table 5 of this specification. A minimum of 65 mm length shall be peeled. First 20 mm and last 20 mm length shall not be counted for assessment of bond strength.
- 10.5.2 In case of non-grafted adhesive, the system shall disbond/ separate cohesively either in adhesive layer

or in polyethylene layer. Majority of the peeled off area on the pipe shall show presence of adhesive. Disbondment/ separation at epoxy to steel interface or epoxy/ adhesive interface or adhesive/ polyethylene interface shall not be permitted. The failure mode shall be recorded for each test. In case of grafted adhesive, cohesive failure mode is not applicable. However, the disbondment is not permitted in the epoxy layer and at the interface of epoxy & steel.

- 10.5.3 In case the test fails to comply the specified requirement, the Applicator shall test the preceding and succeeding coated pipe. If both pipes pass the test, then the remainder of the pipe joints in that shift shall be deemed satisfactory. If either pipe fails to meet the specified requirements, all pipes coated during that shift shall be tested until the coating is proved acceptable. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at Applicator's expense.

#### **10.6 Impact resistance test**

Minimum thirty (30) impacts located equidistant along the length of coated pipe shall be performed. Immediately after testing, the test area shall be subjected to holiday detection at the same voltage as used prior to impact strength test. The pipe shall be rejected if any holiday is noted in the test area. In case of test failure, retesting and disposal of coated pipe shall be as per clause 10.5.3 above.

#### **10.7 Indentation Hardness**

Two samples for each temperature shall be taken from the cut back portion of coated pipe and one in the middle of the pipe for this test. In case of test failure, retesting and disposal of coated pipe shall be as per clause 10.5.3 above.

#### **10.8 Air Entrapment Test**

- 10.8.1 Strips from bond strength tests (peel test) or coated pipe may be used to help determine the porosity of the finished coating. Strip shall be also cut from longitudinal weld (if applicable) at cut back portion and examined for the presence of voids.

- 10.8.2 Bond strength strip shall be viewed from the side and at the failure interface. At the pipe bond strength test location, utility knife shall be used to cut the edge of the coating to a 45° angle and view with a microscope. Similar examination shall be done in the coating cut back area.

- 10.8.3 Strips shall be viewed from the side. All examination shall done using a 30X magnification hand-held microscope. The polyethylene and adhesive layers shall have no more than 10% of the observed area taken up with air entrapment (porosity or bubbles). Air entrapment shall not occupy more than 10% of the thickness in each case. Bubbles shall not link together to provide a moisture path to the epoxy layer.

- 10.8.4 In case of test failure, retesting and disposal of coated pipe shall be as per clause 10.5.3 above.

#### **10.9 Degree of Cure**

- 10.9.1 Epoxy film samples shall be scratched from cut back portion of the coated pipe using hammer and cold chisel and the samples shall be taken for cure test using DSC procedure. Silicon coated sulphite paper shall be placed between the epoxy layer and adhesive layer immediately after epoxy application, to ensure physical separation of epoxy & adhesive as well as to prevent contamination of epoxy with adhesive layer, at a location from where the epoxy samples are to be removed for the test. Care shall be taken to remove the samples of full film thickness avoiding inclusion of steel debris. Glass transition temperature differential (ATg) and % cure (AH) shall comply the specified requirements.

- 10.9.2 In case of test failure, production carried out during the entire shift shall be rejected, unless the Applicator proposes a method to establish the compliance with the degree of cure requirements of all pipes coated during that shift.





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**10.10 Dry Adhesion Test (for epoxy)**

The test shall be carried out at the cut back portion on the pipe from which the Degree of Cure test has been carried out as per clause 10.9 above. In case of test failure, retesting and disposal of coated pipe shall be as per clause 10.9.2 above.

**10.11 Cathodic Disbondment Test**

In case the test fails to conform to the specified requirement, at the option of the Applicator, all pipes coated after the previous acceptable test and prior to next acceptable test shall be rejected or the test shall be repeated using two additional samples taken from the same end of the affected pipe.

When both retests conform to the specified requirement, the lot of pipes shall be accepted. When one or both the retests fail to conform to the specified requirement, all coated pipes after previous acceptable test and prior to next acceptable shall be rejected. All rejected pipes shall be stripped, re-cleaned and re-coated. Company may consider a further retest program to determine whether any of the affected pipe meet the criteria for acceptance upon written request by the Applicator.

**10.12 Elongation at break**

In case the test fails to comply the specified requirement, the Applicator shall test the two preceding and two succeeding coated pipe. If both pipes pass the test, then the remainder of the pipe joints in that batch shall be deemed satisfactory. If either pipe fails to meet the specified requirements, all pipes coated with that batch of PE shall be tested until the coating is proved acceptable. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at Applicator's expense.

**10.13 Hot water immersion**

In case the test fails to comply the specified requirement, the Applicator shall test the two preceding and two succeeding coated pipe. If both pipes pass the test, then the remainder of the pipe joints in that day shall be deemed satisfactory. If either pipe fails to meet the specified requirements, all pipes coated in that day shall be tested until the coating is proved acceptable. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at Applicator's expense.

**10.14** Damages occurring to pipe coating during above tests shall be repaired in accordance with approved coating repair procedure.

**10.15** Repairs occurring on account of the production tests are however excluded from above mentioned limitations at clause 10.4.2 above.

**10.16** Company reserves the right to perform inspection and witness tests on all activities concerning the pipe coating operations starting from bare pipe to finished coated pipe ready for despatch and also testing of raw materials. Applicator shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection to the Company's representative. Inspection and tests performed or witnessed by Company's representative shall in no way relieve the Applicator's obligation to perform the required inspection and tests.

**10.17** In case rate of defective or rejected pipes and/or samples tests are 10% or more for a single shift (typically 8 hours), Applicator shall be required to stop production and carry out a full and detailed investigation and shall submit findings to Company for approval. Applicator shall recommence the production only after getting the written permission from Company.

Under no circumstances any action or omission of the Company's Representative shall relieve the Applicator of his responsibility for material and quality of coating produced. No pipes shall be transported from the coating plant unless authorized by Company in writing.



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**11.0 REPAIR OF COATING**

**11.1 General**

11.1.1 Applicator shall submit to Company, its methods and materials (as per clause 8.2 of this specification) proposed to be used for executing a coating repair and shall receive approval from Company prior to use.

11.1.2 In open storage the repair coating materials must be able to withstand a temperature of at least (+) 80°C without impairing its serviceability and properties. Applicator shall furnish manufacturer's test certificates for the repair materials clearly establishing the compliance of the repair materials with the applicable coating requirements indicated in this specification.

11.1.3 All pipes leaving coating plant shall have sound external coating with no holiday or porosity on 100% of the surface.

11.1.4 Defects, repairs and acceptability criteria shall be as follows:

- Pipes showing porosities or very small damage not picked up during holiday test and having a surface less than 0.5 cm<sup>2</sup> or linear damage (cut) of less than 3 cm shall be repaired by stick using material of same quality.
- Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2 mm and an area not exceeding 20 cm<sup>2</sup> shall be rebuilt by heat shrink patch only and without exposing to bare metal.
- Defects of size exceeding above mentioned area or holidays of width less than 300 mm shall be repaired with heat shrink repair patch by exposing the bare metal surface.
- Defects exceeding the above and in number not exceeding 2 per pipe and linear length not exceeding 500 mm shall be repaired using heat shrinkable sleeves of HTLP 80 or equivalent.
- Pipes with bigger damage shall be stripped and recoated.
- In case of coating defect close to coating cut back, Applicator shall remove the coating throughout the entire circumference of the pipe down to the steel surface and increase the coating cut back length. Now if the coating cut back exceeds 140 mm of linear length of pipe then the coating shall be repaired by the use of heat shrink sleeves thereby making up the coating cut back length of 120 mm.

11.1.5 Notwithstanding the above, if any defect exceeds 70 mm from the original coating cut back length, the entire coating shall be removed and the pipe shall be recycled through the entire coating procedure.

11.1.6 Irrespective of type of repair, the maximum numbers of repair of coating shall be as follows:

- Holiday repair of size 100 cm<sup>2</sup> attributable to process of coating application shall be maximum one number per pipe.
- In addition to the above, defects to be repaired by heat shrink patch/sleeve shall be maximum 2 (two) per pipe.

11.1.7 Defects exceeding the above limits shall cause pipe coating rejection, stripping and recoating. The above is exclusive of the repairs warranted due to testing as per this specification.

All repairs carried out to coating for whatever reason shall be to the account of Applicator.

11.1.8 Cosmetic damages occurring in the polyethylene layer only need not be repaired by exposing up to



steel surface, as deemed fit by the Company Representative. In any case the Applicator shall establish his material, methods and procedure of repair that result in an acceptable quality of product by testing and shall receive approval from Company prior to use.

- 11.1.9 Testing of repairs shall be in the same form as testing coating. All repairs shall result in a coating thickness no less than the parent coating thickness. Applicator shall test repairs to coating as and when required by Company.

## **12.0 MARKING**

Applicator shall place marking on the outside surface of the coating at one end of the coated pipe, and marking shall indicate, but not limited to the following information:

- a. Pipe number, Heat number
- b. Diameter & Wall thickness
- c. Coated pipe number
- d. Colour band
- e. Any other information considered relevant by Company.
- f. Pipe Manufacturer Name
- g. Inspection Mark/ Punch

Applicator shall obtain prior approval on marking procedure to be adopted from the Company.

## **13.0 HANDLING, TRANSPORTATION AND STORAGE**

- 13.1 The Applicator shall be fully responsible for the pipe and for the pipe identification marking from the time of "taking over" of bare pipe from Company until such time that the coated line pipes are 'handed over' and/or installed in the permanent installation as the case may be according to the provisions of the CONTRACT.

- 13.2 At the time of "taking over" of bare pipes, Applicator shall inspect and record all the relevant details referred above including pipe defects in the presence of Company. All pipes shall be checked for bevel damages, weld seam height, dents, gouges, corrosion and other damages. Company Representative shall decide whether pipe defects / damages are suitable for repair. Damage to the pipes that occur after the Applicator has taken delivery such as dents, flats, or damage to the weld ends shall be cut off or removed and pipes rebevelled and repaired again as necessary. The cost of this work, as well as that of the pipe lost in cutting and repair shall be to the Applicator's account. All such works shall be carried out after written approval of the Company. Any reduction in length shall be indicated in the Applicator's pipe tracking system.

- 13.3 The Applicator shall unload, load, stockpile and transport the bare pipes within the coating plant(s) using suitable means and in a manner to avoid damage to pipes. The Applicator shall stockpile the bare pipes at the storage area of the coating plant. The Applicator shall prepare and furnish to Company a procedure/ calculation generally in compliance with API RP 5L 1 for stacking of pipes of individual sizes, which shall be approved by Company prior to commencement.

- 13.4 The bevel protectors shall be removed and stored for reuse after completion of coating application. The ends of the pipes during handling and stacking shall always be protected with bevel protectors.

- 13.5 The Applicator shall load, unload, transport and stockpile the coated pipes within the coating plant using approved suitable means and in a manner to avoid damage to the pipe and coating. The Company shall approve such procedure prior to commencement of work.

- 13.6** Coated pipes may be handled by means of slings and belts of proper width (minimum 60 mm) made of non-abrasive/ non-metallic materials. In this case, pipes to be stacked shall be separated row by row to avoid damages by rubbing the coated surface in the process of taking off the slings. Use of round sectional slings is prohibited. Fork lifts may be used provided that the arms of the forklift are covered with suitable pads, preferably rubber.
- 13.7** Bare/ coated pipes at all times shall be stacked completely clear from the ground, at least 300mm, so that the bottom row of pipes remains free from any surface water. The pipes shall be stacked at a slope so that driving rain does not collect inside the pipe. Bare/ coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can be of dry, germ free straw covered with plastic film, otherwise foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes.
- 13.8** Stacks shall consist of limited number of layers such that the pressure exercised by the pipe's own weight does not cause damages to the coating. Applicator shall submit calculations for Company approval in this regard. Each pipe section shall be separated by means of spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld seam of pipes shall be positioned always in a manner so as not to touch the adjacent pipes.
- 13.9** The lorries used for transportation shall be equipped with adequate pipe supports having as many round hollow beds as there are pipes to be placed on the bottom of the lorry bed. Total width of the supports shall be at least 5% of the pipe length and min. 2 no. support shall be provided. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection must be free from all nails and staples where pipes are in contact. The second layer and all following layers shall be separated from the other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.
- 13.10** All stanchions of Lorries used for transportation shall be covered by non-abrasive material like rubber belts or equivalent. Care shall be exercised to properly cover the top of the stanchions and other positions such as reinforcement of the truck body, rivets, etc. to prevent damage to the coated surface. Slings or non-metallic straps shall be used for securing loads during transportation. They shall be suitably padded at the contact points with the pipe
- 13.11** Materials other than pipes and which are susceptible of deteriorating or suffering from damages especially due to humidity, exposure to high thermal excursions or other adverse weather conditions, shall be suitably stored and protected. Deteriorated materials shall not be used and shall be replaced at Applicator's expenses. These materials shall always be handled during loading, unloading and storage in a manner so as to prevent any damage, alteration and dispersion. When supplied in containers and envelopes, they shall not be dropped or thrown, or removed by means of hooks, both during the handling operations till their complete use. During unloading, transport and utilization, any contact with water, earth, crushed stone and any other foreign material shall be carefully avoided.
- 13.12** Applicator shall strictly follow Manufacturer's instructions regarding storage temperature and methods for volatile materials that are susceptible to change in properties and characteristics due to unsuitable storage. If necessary the Applicator shall provide for a proper conditioning.
- 13.13** In case of any marine transportation of bare/coated line pipes involved, the same shall be carried out in compliance with API RP 5LW. Applicator shall furnish all details pertaining to marine transportation including drawings of cargo barges, storing/stacking, sea fastening of pipes on the barges/marine vessels to the company for approval prior to undertaking such transportation works. In addition,



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Applicator shall also carry out requisite analyses considering the proposed transportation scheme and establish the same is safe and stable. On-deck overseas shipment shall not be allowed.

**14.0 MEASUREMENT AND LOGGING**

Applicator shall maintain records in computer using MS ACCESS database Software containing all the relevant data of individual pipe and pipe coating including pipe number, heat number, diameter, length, wall thickness, defects, coating number, batches of materials, sampling, testing, damages, repairs, rejects and any other information that Company considers to be relevant and required for all incoming bare pipes and Company approved outgoing coated pipes as applicable. Applicator's documentation shall be designed to ensure full traceability of pipe and coating materials through all stages of coating and testing. Applicator shall submit this information in the form of a report at the agreed intervals. The above data shall also be provided in MS ACCESS format in Compact Disc (CD). Applicator shall provide one Computer Terminal to Company Representative for monitoring/tracking of the above. The Applicator shall also submit the material balance details to Company for information at the end of each shift.

### ANNEXURE I

#### List of Acceptable Combinations of Coating Materials

The following combinations of coating materials are considered acceptable. In case any of the combinations listed below are offered, details regarding properties of the offered materials need not be furnished with bid. However, In the event of award of contract, Applicator shall furnish the combination(s) proposed as per Table below and re-confirmation of compatibility of the proposed combination (s) from the raw materials Manufacturers. Only straight-line combination of epoxy, adhesive and PE compound is acceptable.

<b>Epoxy Powder (Manufacturer)</b>	<b>Adhesive (Manufacturer)</b>	<b>PE Compound (Manufacturer)</b>
CORRO-COAT EP-F 2001 (JOTUN)	FUSABOND 158D (DUPONT)	SCLAIR 35 BP HDPE (NOVACOR)
CORRO-COAT EP-F 2002HW (JOTUN) or SCOTCHKOTE 226N (3M)	LUCALEN G3710E (LYONDELLBASELL)	LUPOLEN 4552 D SW 00413 (LYONDELLBASELL)
PE 50-6109 (BASF) or CORRO-COAT EP-F 2001/ 2002HW (JOTUN) / JOTAPIPE AC 1003 (JOTUN) or SCOTCHKOTE 226N (3M)	ME 0420 (BOREALIS)	HE 3450H (BOREALIS / BOROUGE)
CORRO-COAT EP-F 2001 (JOTUN)	LE — 149 V (HYUNDAI ENGINEERING PLASTICS)	ET 509 B (HYUNDAI ENGINEERING PLASTICS)

Although the above combinations would be acceptable to Company, the responsibility of suitability for application, performance and compliance to the coating system requirements shall unconditionally lie with the Applicator.



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Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by



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### ABBREVIATIONS:

CE	Carbon Equivalent	NDT	Non Destructive Testing
CIMFR	Central Institute of Mining & Fuel Research	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	MR	Material Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MPT/MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate		
MRT	Mechanical Run Test		



# INSPECTION AND TEST PLAN FOR ELECTRIC WELDED LINE PIPES

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## 1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Electric Welded Line Pipes.

## 2.0 REFERENCES

PO / PR / Standards referred there in / Job specifications / Approved documents.

## 3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	OWNER/PMC/TPIA
1.0	<b>Procedure</b>						
1.1	Hydrostatic Test, Heat Treatment, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New, R- Existing (Qualified under Reputed TPIA)
2.0	<b>Raw Material Procurement</b>						
2.1	Inspection of Coils at Mills (Sub vendor works)	Chemical & Mechanical Properties, Method of manufacturing, Heat Treatment Condition etc.	100%	Mill Test Certificates (EN 10204-3.2)	H	H (Note-3)	R (Note-3)



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<b>3.0</b>	<b>In Process Inspection</b>						
3.1	First Day Production test	All testing requirement as per PR/ MR	As per PR/ MR	Test Report	-	H	H
3.2	Raw material Inspection	Heat No, Coil /Plate, Visual & Dimension	100%	Inspection Reports	-	H	RW (Min.1%)
3.3	Coil /Skelp UT as applicable	1) 25mm (Min) from edges 2) 20 % Min Coverage in Bal. part of Coil/ Plate	100%	Inspection Reports	-	H	RW (Min.1%)
3.4	Pipe Forming & Welding	Offset & Welding Parameters	100%	Inspection Reports	-	H	-
3.5	Heat Treatment	Weld Seam Normalising, Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment , Heat Treatment temperature etc. as applicable	100%	HT Graph / Record	-	H	R
<b>4.0</b>	<b>Final Inspection</b>						
4.1	Hydrostatic Testing	Leak & pressure Drop, Calibration of Gauges/ Recorder	100%	Inspection Report	-	H	RW (Min.5%)





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4.2	Final weld UT & Pipe body UT ( If applicable)	Calibration, Seam Tracking. & Examination of Defects	100%	Inspection Report	-	H	RW (Min.5%)
4.3	Manual UT of Pipe end	Welding defects, crack/ lamination of base metal	100%	Inspection Report	-	W	RW (Min.1%)
4.4	Inspection of Pipe ends MPT	1. Examination of Surface Defects after Beveling 2. Demagnetization	100%	Inspection Report	-	H	RW (Min.1%)
4.5	Final visual and dimension	1. Visual Examination 2. Dimensional Check Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc.	100%	Inspection Report	-	H	RW (Min.5%)
4.6	Weight Checking as applicable	Weight	100%	Inspection Report	-	H	-
4.7	Lot Testing	1. Chemical Analysis 2. Tensile Tests 3. Flattening 4. Reverse Bend Test 5. Macro & Hardness Tests 6. Impact Tests 7. Drop Weight Tear Test, etc. as applicable	100%	Inspection Report	-	H	W



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4.8	Non-conforming product/stage	Repair / Retest /Reject	100%	Inspection Report	-	H	RW
4.9	Marking/Stenciling	Pipe No, Acceptance No., Heat. No., Size, Weight, Grade, Thickness, Colour Code etc	100%	Inspection Report	-	H	RW (Min.5%)
<b>5.0</b>	<b>PAINTING</b>						
5.1	Rust Preventive Coating & Colour Coding	Visual & Colour Coding as applicable	100%	Inspection Report	-	H	-
<b>6.0</b>	<b>Documentation &amp; IC</b>						
6.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports/ Test Reports & Issue of IC	100%	Manufacturer TC & IC	-	H	H
6.2	Final documents as per PR/MR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

**Legend:** H - Hold (Do not proceed without approval), P - Perform, RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]), R - Review, W - Witness (Give due notice, work may proceed after scheduled date).



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### NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon). Supplier shall submit specific ITP for Approval.
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in/ Job Specification /Approved Documents.
3. Raw Material (Coils) shall be inspected at Mills (Sub vendors works) by TPIA appointed by Supplier.
4. Supplier shall issue EN 10204-3.2 certificate based on this ITP/ MR/ PR for the Pipes (Final Product).



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### ABBREVIATIONS:

CE	Carbon Equivalent	NDT	Non Destructive Testing
CIMFR	Central Institute of Mining & Fuel Research	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	MR	Material Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MPT/MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate		
MRT	Mechanical Run Test		



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## 1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of 3-Layer PE Coating of Line pipes

## 2.0 REFERENCES

PO / PR / Standards referred there in / Job specifications / Approved documents.

## 3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
1.0	<b>Procedure</b>						
1.1	Coating application, testing and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	<b>Material Inspection</b>						
2.1	Epoxy powder, Adhesive & Polyethylene compound	All the properties as per Material specification	100%	Manufacturer Test Certificates	H	R	R



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<b>3.0</b>	<b>In Process Inspection</b>						
3.1	Epoxy powder, Adhesive & Polyethylene compound check testing	Properties as per Material specification	100%	Test Reports	-	H	H
3.2	Coating Procedure qualification	All the testing as per Material specification	As per Material Specification	Inspection/Test Report	-	H	H
3.3	Incoming Pipes	Visual inspection, marking verification & correlation with mill TC/Tally sheet	100%	Supplier Data Sheet	-	H	-
3.4	Blast Cleaning	Pre Heating, Elapsed time, Degree of cleaning, Surface Profile, Contamination of shots/grits, salt level, Degree of dust & roughness	100%	Inspection Reports	-	H	RW (Min.1%)
3.5	Lab test for Chromate, Phosphoric acid & de-ionized water (as applicable)	Properties as per purchase specification / Manufacturer TC	As per Material Specification	Inspection Reports	-	H	RW (Once in a Day)



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3.6	Phosphoric acid wash followed by de-ionized water wash ( as applicable)	Visual, PH Value, salt level etc.	100%	Inspection Reports	-	H	RW (Once in a Day)
3.7	Chromate Treatment (as applicable)	Uniform application as per Manufacturer's recommendation	100%	Inspection Reports	-	H	RW (Once in a Day)
3.8	Coating application	Preheating temperature, Inter coat time, line speed, Adhesive / PE film temperature, Overlap of layers etc.	100%	Inspection Reports	-	H	RW (Min.1%)
3.9	Epoxy and adhesive Thickness on semi coated pipe	Visual, Thickness, overlap, Adhesion test (St Andrew's Cross Cut method) etc.	As per Material Specification	Inspection Reports	-	H	W
<b>4.0</b>	<b>Final Inspection</b>						
4.1	Holiday detection at 25KV	Pin hole, coating damage & Other through thickness defects.	100%	Inspection Report	-	H	RW (Min.1%)
4.2	Visual and Dimensional	Visual, coating thickness, Cut back dimension, Marking , colour coding etc.	100%	Inspection Report	-	H	RW (Min.1%)





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4.3	Impact test	No coating damage @ specified Energy	As per Material Specification	Inspection Report	-	H	W
4.4	Peel Test	Bond strength, mode of failure, rate of peeling etc.	As per Material Specification	Inspection Report	-	H	RW (Min.1%)
4.5	Resistance to indentation test	Hardness against indentation	As per Material Specification.	Inspection Report	-	H	W
4.6	Cathodic Disbondment Test	Disbonded area / Equivalent circle radius (ECR)	As per Material Specification	Inspection Report	-	H	W
4.7	Dry Adhesion Test	Epoxy Coating resists Disbondment from the steel (rating 1 or 2)	As per Material Specification	Inspection Report	-	H	W
4.8	Hot water immersion test	Average less than or equal to 2 and maximum less than or equal to 3 as per ISO 21809-1	As per Material Specification	Inspection Report	-	H	W



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4.9	Elongation at Break	Minimum 400%	As per Material Specification	Inspection Report	-	H	W
4.10	Visual ( Air Entrapment)	Air entrapment between the layers	As per Material Specification	Inspection Report	-	H	W
4.11	Degree of Cure Test	Cure %, Glass Transition Temp( $\Delta H$ and $\Delta T_g$ )	As per Material Specification	Inspection Report	-	H	W
4.12	Calibration of measuring Instruments / Holiday tester	Verify Accuracy	As per Material Specification	Calibration Report	-	H	R
4.13	Handling, Load out & Transportation (Bare & coated pipes)	Pipes stacking & weather protection	As per Material Specification	Inspection Report	-	H	-
<b>5.0</b>	<b>Documentation &amp; IC</b>						



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5.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC	-	H	H
5.1	Final Document submission	Compilation of Inspection / Test reports as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H
<b>Legend:</b> H - Hold (Do not proceed without approval), P - Perform, RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]), R - Review, W - Witness (Give due notice, work may proceed after scheduled date).							

### NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/MR/STANDARDS referred there in /Job Specification /Approved Documents.



# CHECKLIST - TECHNICAL

DOCUMENT NO.  
P-STD-001

## CHECKLIST – TECHNICAL

Bidder confirms following, as a minimum, has been enclosed in the offer.

S.NO.	Requirements	Compiled by Bidder(Tick)
1	Reference List of previous supply of Procured item	<input type="checkbox"/>
2	Filled – up Data Sheets, duly signed and stamped by bidder enclosed.	<input type="checkbox"/>
3	List of recommended commissioning spares and accessories for Procured item.	<input type="checkbox"/>
4	List of recommended spares and accessories for two year normal operation for procured item.	<input type="checkbox"/>
5	Compliance statement duly filled and stamped enclosed.	<input type="checkbox"/>
6	GA & assembly drawings, cross section drawings including part list & material list enclosed.	<input type="checkbox"/>
7	Other technical details & vendor's product catalogues enclosed.	<input type="checkbox"/>

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0	04.01.2022	ISSUED AS STANDARD	PNS	MD	AD
<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREP</b>	<b>CHK</b>	<b>APPR</b>

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COMPLIANCE STATEMENT

S.No	Requirement	Bidder's Confirmation
1	Bidder confirms that all materials proposed by the bidder are same/ superior to those specified in specification/ data sheets enclosed.	
2	Bidder confirms that the offer is in total compliance with the Technical requirements of the Material Requisition. Bidder confirms that deviation expressed or implied anywhere else in the offer shall not be considered valid.	
3	Bidder confirms that all spares and accessories required for two years of normal operation have been quoted separately.	
4	Bidder confirms that prices for start-up/commissioning spares and accessories have been included in the quoted items.	
5	Bidder confirms that in the event of securing order for the requisitioned item(s), good for manufacturing drawings of ordered item(s) shall have complete details with dimensions, part list and material list including back-up calculations in the first submission, failing which the vendor shall be solely responsible for any likely delay in delivery of item(s).	

Bidder's Signature with Stamp

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0	04.01.2022	ISSUED AS STANDARD	PNS	MD	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR

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# DEVIATION SHEET

DOCUMENT NO  
P-STD-004

## DEVIATION/ EXCEPTION/ CLARIFICATION SHEET

S.No.	Contractor's Inquiry Reference	Contractor's Requirement	Proposed Deviation by Supplier, with Technical Justification	Cost Impact, if any	Contractor's Conclusions

### NOTES

- 1- Bidder confirms that apart of from the deviations/exceptions/clarifications listed above, the bid is in full compliance with Inquiry requisition.
- 2- Bidder shall submit this sheet duly filled up and signed by him along with his bid. In case there is no deviation, then also supplier shall submit this sheet along with his bid indicating NIL deviation.

(Contractor's Name and Signature with Seal)

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0	04.01.2022	ISSUED AS STANDARDS	PNS	MD	AD
<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREP</b>	<b>CHK</b>	<b>APPR</b>

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**INFORMATION/ DOCUMENTS / DRAWINGS TO BE SUBMITTED BY SUCCESSFUL BIDDER**

Successful Bidder shall submit four copies unless noted otherwise, each of the following:

1. Inspection & test reports for all mandatory tests as per the applicable code as well as test reports for any supplementary tests, in nicely bound volumes.
2. Filled in Quality Assurance Plan (QAP) for Purchaser's/ Consultant's approval. These QAPs shall be submitted in two copies within 15 days from LOI/ FOI.
3. Detailed completion schedule activity wise (Bar Chart), within one week of placement of order.

NOTE:- All drawings, instructions, catalogues, etc., shall be in English language and all dimensions shall be metric units.

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0	04.01.2022	ISSUED AS STANDARDS	PNS	MD	AD
<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREP</b>	<b>CHK</b>	<b>APPR</b>

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# INSTRUCTION TO BIDDER

DOCUMENT NO.  
P-STD-006

## INSTRUCTION TO BIDDERS

1. Bidder to note that no correspondence shall be entered into or entertained after the bid submission.
2. Bidder shall furnish quotation only in case he can supply material strictly as per this Material Requisition and specification/data sheet forming part of Material Requisition.
3. If the offer contains any technical deviations or clarifications or stipulates any technical specifications (even if in line with MR requirements) and does not include complete scope & technical/performance data required to be submitted with the offer, the offer shall be liable for rejection.
4. Bidder must submit all documents as listed in checklist with his offer.
5. Supplier must note that stage wise inspection for complete fabrication, testing including the raw material inspected to be carried out.
6. Vendors for bought out items to be restricted to the approved vendor list attached with bid document. Approval of additional vendor if required, for all critical bought out items shall be obtained by the supplier from the purchaser before placement of order. Credentials/PTR of the additional vendor proposed to be submitted by supplier for review and approval of Purchaser/Purchaser's representative

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0	04.01.2022	ISSUED AS STANDARDS	PNS	MD	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR

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# REFERENCE LIST

DOCUMENT NO.  
P-STD-002

## REFERENCE LIST

SI No.	Project	Year of Supply	Client , Address and Contact No.	Email	Size and Rating/ thk	Service
<b>Bidder's Signature with stamp</b>						

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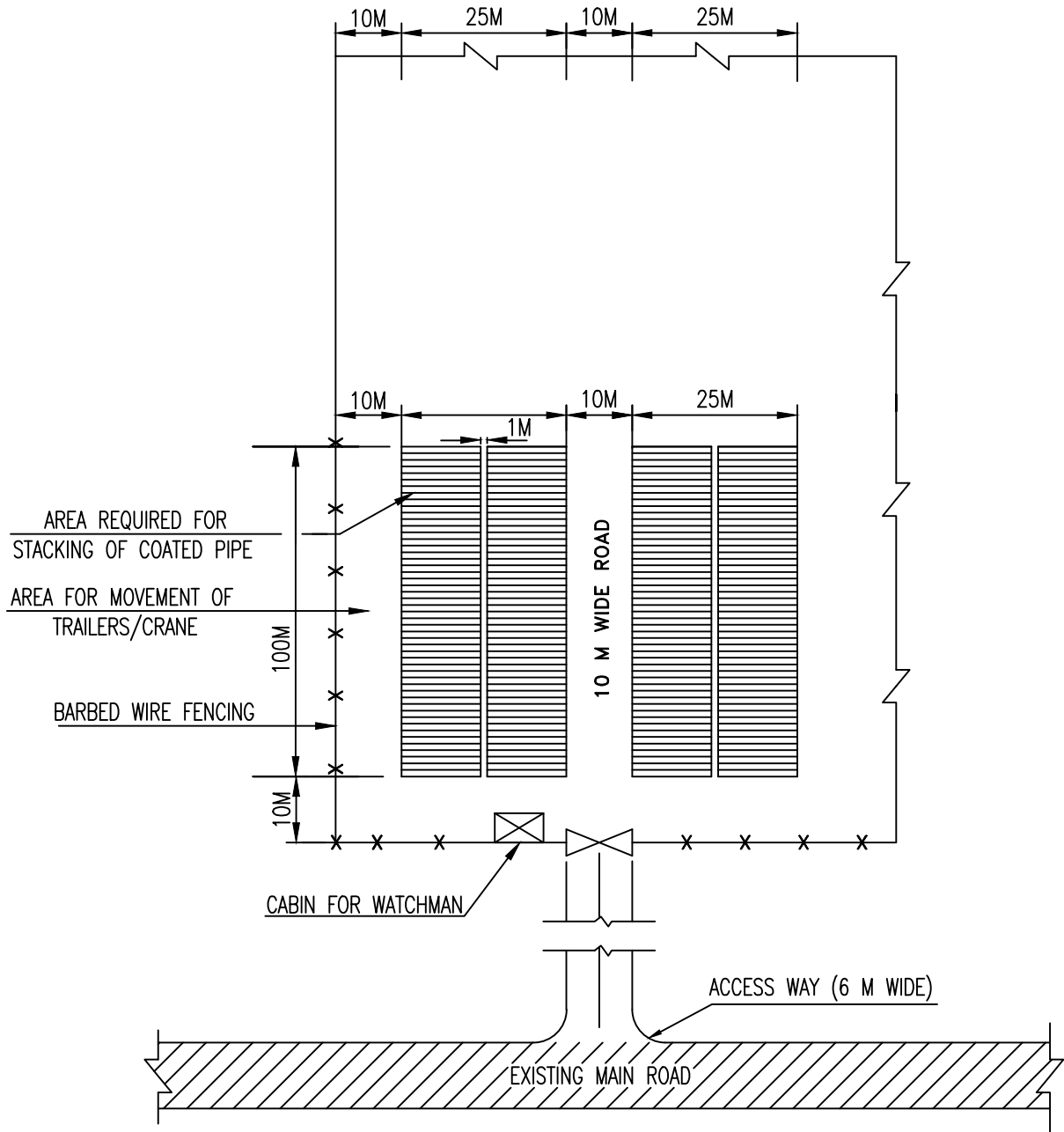
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0	04.01.2022	ISSUED AS STANDARDS	PNS	MD	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



**LIST OF RECOMMENDED THIRD PARTY INSPECTION AGENCY (TPIA)****CONSULTANT:****Pipeline Engineering Consultants Private Limited (PLECO)**

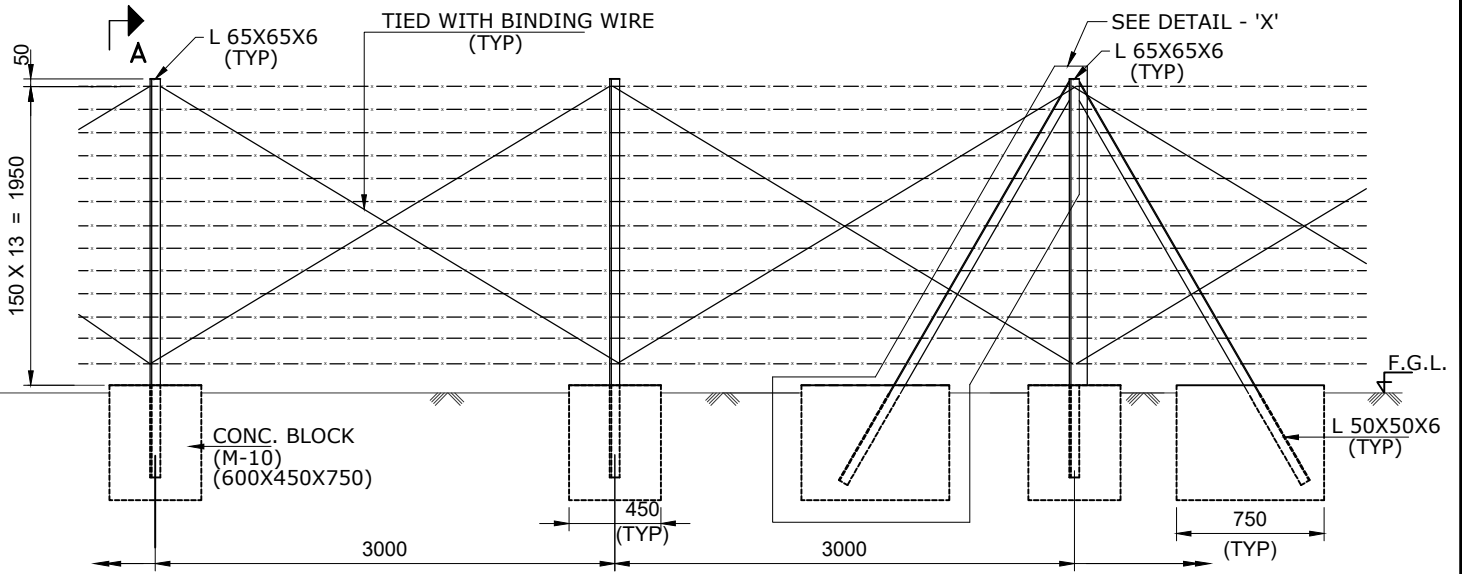
SL. NO	NAME OF TPI	ADDRESS	PHONE NO	FAX NO
1	Tata Projects Ltd.	22,Sarvodaya Society,Nizampura,Baroda-390002	0265-2392863	0265-2785952
2	Bax counsel Inspection Bureau Pvt. Ltd.	303, Madhava,Bandra Kurla Complex, Bandra(E),Mumbai-400051	022-26591526,022-26590236	022-26591526
3	Germanischer Lloyd	4th Floor, Dakshna Building, Sec-11, Plot NO.2, CBD Belapur, Navi Mumbai 400 614	022-4078 1000	022-4024 2935
4	ABS Industrial Verification Ltd., Mumbai	404,Mayuresh Chambers,Sector-11,CBD Belapur(E),Navi Mumbai-400614	022-27578780 /1 /2	022-27578784 / 5
5	Certification Engineers International Ltd.	EIL Bhavan,5th floor,1,Bhikaji Camma Place, New Delhi-110066	011-26167539,26102121	011-26101419
6	Dalal Mott MacDonald	501, Sakar -II, Ellisbridge,Ahemedabad-380006	079-26575550	079-6575558
7	International Certification Systems	E-7,Chand Society, Juhu Road, Juhu, Mumbai-4000049	022-26245747	022-226248167
8	SGS	SGS India Pvt. Ltd.,SGS House,4B,A.S.Marg,Vikhroli(W),Mumbai-400083	022-25798421 to 28	022-25798431 to 33
9	Intertek Moody	9th Floor, Kanchenjunga Building, 18-Barakhamba Road, New Delhi-110001	011-4713 3900	011-4713 3999
10	TUV SUD South Asia	C-153/1, Okhla Industrial Ara, Phase-1, New Delhi-110020	011-3088 9611/9797	011-3088 9598
11	TUV Rheinland (India) Pvt. Ltd.	F-51, Kailash Complex GF, Veer Savarkar Marg, Vikhroli Park Site, Vikhroli(W), Mumbai-400079	022-4215 5435	022-4215 5434
12	Vincott International India Assessment Service Pvt. Ltd.	C-301, Mangalya Premises Cooperative Soc. Ltd, Off. Marol Maroshi Road, Andheri(E), Mumbai-400959	022-4247 4100	022-4247 4101
13	Meenar Global Consultants	Mr. Nitin Taneja (Project Manager)	M: +91-9711212783 T: +91-129-4072836	Web : www.meenaar.in Email : nitin.taneja@meenaar.in
14	VCS Quality Services Pvt. Ltd.	505, 5th floor, 360 Degree Business Park, Next to R-Mall, L.B.S. Marg, Mulund West, Mumbai 400080	Tel: 91 22 21649720	091 22 21646392



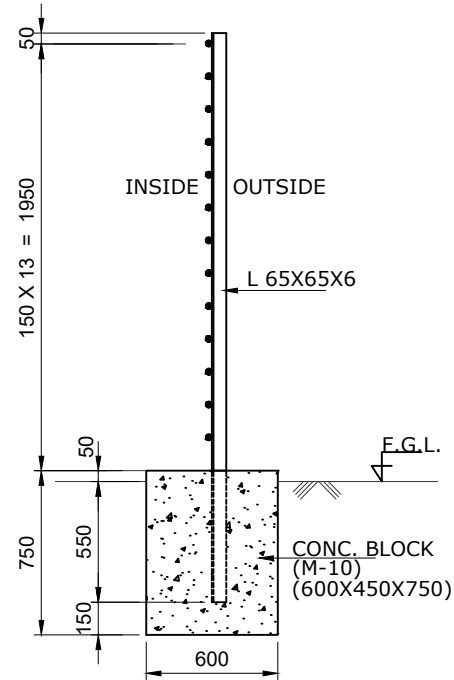
**NOTES :**

1. ARRANGEMENT SHOWN IS INDICATIVE ONLY AND SHALL BE DEVELOPED BY CONTRACTOR/VENDOR DEPENDING UPON THE AREA REQUIRED.
2. DEVELOPMENT OF DUMPSITE SHALL BE AS PER SCOPE OF WORK DOCUMENT.
3. AREA FOR DUMPSITE SHALL BE FINALISED BASED ON LINE PIPES QUANTITIES.
4. STACKING AND NO. OF LAYER OF PIPE SHALL BE APPROVED BY COMPANY.

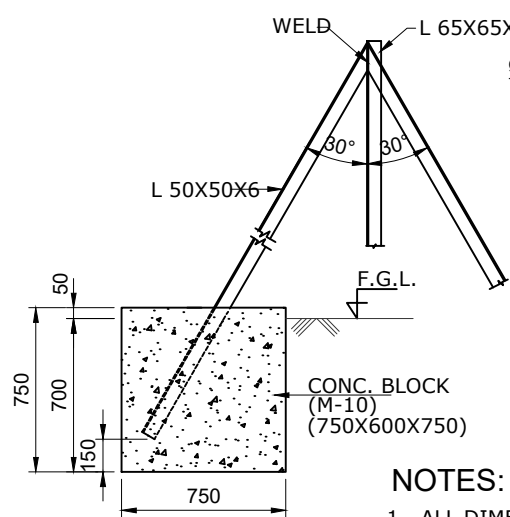
0	04.02.22	ISSUED WITH TENDER	DK	SM	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



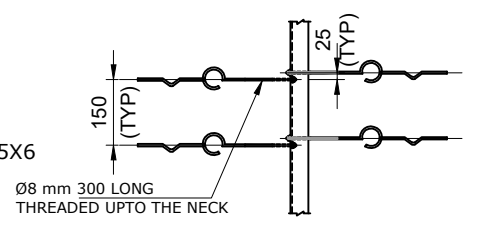
**BARBED WIRE FENCE**  
(OUTSIDE)



**SECTION ELEVATION A - A**



**DETAIL - X**



**FIXING DETAIL OF STRAINING BOLT WITH POST**

**NOTES:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE GALVANIZED STEEL BARBED WIRE DESIGNATED AS STEEL BARBED WIRE A-1 TO IS:278 SHALL HAVE LINE WIRE OF Ø2.5MM, POINT WIRE OF Ø 20MM & MINIMUM WEIGHT OF COMPLETE BARBED WIRE SHALL BE 108gm/m WITH 75mm DISTANCE BETWEEN TWO BARBED WIRES.
3. LINE POST SHALL BE PLACED AT 3.0M C/C.
4. STRUT SHALL BE PROVIDED AT EVERY 15TH. POST OF BOTH SIDE & END POST ON ONE SIDE.
5. STRAINING BOLTS SHALL BE PROVIDED AT THE END POST & AT PLACES AS DIRECTED BY ENGINEER INCHARGE.
6. EXPOSED FOUNDATION BLOCK AT GROUT LEVEL SHALL BE FINISHED SMOOTH IN CEMENT MORTAR 1:6.
7. GALVANIZED BARBED WIRE SHALL BE TIED TO THE ANGLE IRON POST EITHER WITH WELDED M.S NIBS OR WITH G.I WIRE THROUGH HOLES IN THE POST.

0	08.03.22	ISSUED FOR STANDARD	SP	ADh	AD
REV.	DATE	DESCRIPTION	BY.	CHKD.	APPD.
ENGINEERING CONSULTANT:		DWG. TITLE :		DOC. NUMBER	REV.
<b>PIPELINE ENGINEERING CONSULTANTS PVT. LTD.</b>		<b>DETAIL OF BARBED WIRE FENCING (WITH ANGLE IRON POST)</b>		C-STD-054	0
				SCALE : NTS	SHEET 1 OF 1