



## GOLAGHAT-BCPL LAKWA PIPELINE PROJECT

# MATERIAL REQUISITION FOR INSULATING JOINT

Doc No: P101-MRR-P003

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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
HFV	High Frequency Welding
3LPE	3 Layer Polyethylene
SMYS	Specified Minimum Yield Strength
OD	Outer Diameter
SMLS	Seamless



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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 Insulating Joint 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.) long Carbon Steel Pipeline from Golaghat Station to BCPL plant
- Laying of 12" x 2 KM (approx.) long 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 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. Data Sheet
- b. MR
- c. Basic Documents (Specifications)
- d. 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

Design, procurement of materials and bought out components, manufacture, assembly at shop, inspection, testing at manufacturer's works, packing, delivery of Insulating Joints at owner designated store including supply of all pre commissioning & commissioning spares & documentation as per the enclosed engineering standard, specifications and data sheets etc. attached or referred.

**Scope of supply of Insulating Joint:**

Size	Rating	IJ Material	Connecting Pipe Material & WT	Data sheet	Installation Location	Qty	Data Sheet Sht. No.
12"	300#	ASTM A694 GR.F42	API 5L GR.X-42 & 7.1 mm	P101-DSH-P003	Note 1	7	Sht. 2 OF 4
4"	300#	ASTM A694 GR.F42	ASTM A 106 Gr B (CHARPY), SCH XS	P101-DSH-P003	Note 2	7	Sht. 3 OF 4
2"	300#	ASTM A694 GR.F42	ASTM A 106 Gr B (CHARPY), SCH XS	P101-DSH-P003	Note 3	14	Sht. 4 OF 4

**Note-1**      1 no in Golaghat Dispatch Terminal  
                  2 no's in BCPL Lakwa Receipt Terminal  
                  1 no in "O" Point Receipt Station  
                  3 no along Golaghat to BCPL (SV-2, SV-4 & SV-6) Pipeline route.

**Note-2**      7 no's along Golaghat to BCPL (SV-1 SV-2, SV-3, SV-4, SV-5, SV-6 & SV-7) Pipeline route.

**Note-3**      14 no's along Golaghat to BCPL (SV-1 SV-2, SV-3, SV-4, SV-5, SV-6 & SV-7) Pipeline route.

**Legends:**      WT- Specified Wall Thickness (mm), AG-Above Ground, IJ- Insulating Joint, TOP- Tap-off Point & SV Sectionalizing Valve.

## 7.0 NOTES:

1. Vendor shall ensure that internal bore size of Insulating Joints should match with the adjacent pipe. The Insulating Joints shall be suitable for pipeline pigging operation.
2. Butt welding end of Insulating Joints shall be bevelled as per API 5L to match connecting pipe wall thickness.
3. Vendor shall confirm the heat generated during welding at site is not detrimental to the isolating and filler materials and internal coating. Vendor shall propose appropriate measure needs be taken during field welding.
4. Supply of Pup of length min. 500mm shall be welded on both side of Isolation joint shall be in vendor Scope. Pup piece material shall be same as line pipe.
5. Insulating Joints (including all components) shall be designed and suitable for NG. Insulating Joints material shall be subjected to Charpy V-notch tests & Hardness test as per standard specification for insulating joint (Doc. No. P-SPC-312).

## MATERIAL REQUISITION FOR INSULATING JOINT

6. Design Data for the Project are:

- Pipeline Service : NG
- Design Pressure : 49 Kg/cm<sup>2</sup>
- Max Design Temp (Above Ground) : 65 ° C
- Min Design Temp : (-) 29 ° C

7. All materials shall be Charpy V-notch tested for each heat of steel. Test shall confirm to the provisions of ASTM A-370 and at temp of -29° C.
8. Insulating Joints shall be internally coated with liquid epoxy paint with DFT of 30 to 50 microns.
9. Quantity may vary by  $\pm 25$  %. The final quantity will be issued to successful bidder.
10. Certification shall be EN 10204 type 3.2.
11. Vendor shall check all calculations of insulating Joints based on design conditions and manufacturing requirements and submit necessary documents to company for approval.
12. Vendor shall furnish the allowable forces and moments for the axial, lateral and transverse (i.e. x, y and z directions) along with Bending and transverse forces for review.
13. Delivery of Insulating Joints shall be at AGCL store near Golaghat, Assam. All transportation, handling, delivery will be in the Bidder's scope. Also Vendor shall arrange checking of all material as per item list before handling over. In case materials are packed in boxes, boxes shall be open for after inspection. All transportation, handling, delivery shall be in bidder's scope.
14. Bidder shall furnish quotation only in case he can supply material strictly as per this MR and specification/ data sheets forming part of MR.
15. 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).
16. 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.
17. Bidder must submit all documents/ drawings/ calculations as specified in relevant specification along with his offer and after award of order.
18. The internal and external coating of Insulating joint shall be as per Specification of Insulating joint (Doc No. P-SPC-312).
19. Purchaser's inspector reserves the right to perform stage wise inspection and witness tests, as indicated in specification for Insulating joint 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.

## 8.0 LIST OF ATTACHMENTS

1. Specification for insulating joint Doc No. P-SPC-312.
2. Standard Specification for HFW Line Pipe. Doc No. P-SPC-002.
3. Painting Specification Doc. No. P-SPC-410
4. Data Sheet for Insulating Joint Doc. No. P101-DSH-P003
5. ITP, Doc no Doc. No. P-ITP-005
6. Check List, Doc. No. P-STD-001
7. Compliance Statement, Doc No. P-STD-003
8. Deviation Sheet, Doc. No. P-STD-004
9. Drawings & Documents, Doc. No. P-STD-005
10. Instruction to Bidders, Doc No. P-STD-006
11. Reference List, Doc. No. P-STD-002
12. Vendor Drawing Document Schedule, Doc. No. P-STD-007
13. TPI List

## **GOLAGHAT-BCPL LAKWA PIPELINE PROJECT**

### **DATA SHEET - INSULATING JOINT**

**Document Number :- P101-DSH-P003**

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**STANDARD SPECIFICATION  
FOR INSULATING JOINTS  
(ONSHORE)**

**SPECIFICATION NO.  
P-SPC-312**

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**STANDARD SPECIFICATION  
FOR  
INSULATING JOINTS  
(ONSHORE)**

**P-SPC-312**

0	03.01.22	ISSUED AS STANDARD SPECIFICATION	RK	MD	AD	SK
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**ABBREVIATIONS**

API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing and Materials
BHN	:	Brinell Hardness Number
CE	:	Carbon Equivalent
DN	:	Nominal Diameter
HAZ	:	Heat Affected Zone
LPG	:	Liquefied Petroleum Gas
LTCS	:	Low Temperature Carbon Steel
MSS-SP	:	Manufacturers Standardization Society - Standard Practice
RTJ	:	Ring Type Joint
SSPC	:	Steel Structures Painting Council



# STANDARD SPECIFICATIONS FOR INSULATING JOINTS (ONSHORE)

SPECIFICATION NO.  
P-SPC-312

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## **1.0 GENERAL**

This specification covers the minimum requirements for the design, manufacture and supply of carbon steel insulating joints to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## **2.0 REFERENCE DOCUMENTS**

Reference has been made of the in this specification to the latest edition (edition enforce at the time of issue of enquiry) following codes, standards and specifications:

- a) ASME B 31.4 : Pipeline Transportation Systems for Liquids and Slurries.
- b) ASME B 31.8 : Gas Transmission and Distribution Piping Systems.
- c) ASME B 16.5 : Steel Pipe Flanges and Flanged Fittings..
- d) ASMEB 16.25 : Buttwelding Ends
- e) ASTM A 370 : Standard - Test Methods and Definitions for Mechanical Testing of Steel Products.
- f) ASME Sec VIII : Boilers & Pressure Vessel Code - Rules for the Construction of Pressure Vessels.
- f) ASME Sec IX : Boilers & Pressure Vessel Code - Welding and Brazing Qualifications.
- g) API 1104 : Standards for Welding of Pipelines and Related Facilities.
- i) MSS-SP-53 : Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Magnetic Particle Examination Method.
- j) MSS-SP-75 : Specification for High Test Wrought Welding Fittings.
- k) NACE SP 0286 : Standard Recommended Practice - Electrical Isolation of Cathodically Protected Pipelines
- k) SSPC-VIS-1 : Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
- l) API 5L : Specification for Line pipe

In case of conflict between the requirements of this specification and the codes, standards and specifications referred above, the requirements of this specification shall govern.

## **3.0 MATERIALS**

**3.1** Materials for the pressure containing parts of the insulating joints shall be as indicated in the insulating joints Data Sheet. Other parts shall be as per Manufacturer's standard (suitable for the service conditions indicated in the Insulating Joint Data Sheets), which shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.

All process-wetted parts, metallic and non-metallic shall be suitable for the commissioning fluids and service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/seawater environment, which may be used during field testing.

**3.2** The Carbon Steel used in the manufacture of flow tees shall be fully killed.

- 3.3** Insulating Joints which are subject to field welding by Company, shall have carbon equivalent (CE) not greater than 0.45 based on check analysis for each heat of steel used, as calculated by following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

- 3.4** For insulating joints specified to be used for Gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel used in the manufacture of all pressure containing parts including pipe pups & retainer rings of Insulating Joints. The test procedure shall conform to ASTM A370. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0° C. The average absorbed energy value of three full sized specimens shall be 27 J. The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J. Results of Charpy test shall be recorded.

When Low Temperature Carbon Steel (LTCS) materials are specified in Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

- 3.5** For insulating joints specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used in the manufacture of all pressure containing parts. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, weld metal and HAZ of all the pressure containing parts shall not exceed 248 HV 10. Hardness shall be recorded.

- 3.6** Insulation material shall be minimum 20 mm thick and Insulating Joint shall comply with Section 6, NACE SP 0286.

## **4.0 DESIGN AND FABRICATION**

### **4.1 Mechanical**

- 4.1.1** Insulating joints shall be of integral type fabricated by welding and with pups on either side as shown in Fig. 4.1 & Fig. 4.2. Bolted and threaded joints are not permitted. Insulating Joints of design, not having closing welds, are not acceptable.

- 4.1.2** Insulating joints shall be designed using the design principles of ASME Section VIII Div. 1. The design shall be checked for the following two cases:

Case I: Design pressure (as per Data Sheet) and Axial Force (F).

The Axial force shall be calculated as under:

$$F = 0.1 \times S \times A$$

Where

SMYS of connected pipe (refer Data Sheet)

A = Metal cross-sectional area of connected pipe.

The allowable stress in this case shall be less than or equal to 0.5 x SMYS .of insulating joint material.

Case II : Hydrostatic Test Pressure

The allowable stress in this case shall be less than or equal to 90% of SMYS of insulating joint material.

All design parameters shall be as per Insulating Joint Data Sheet. Detailed design calculations shall be submitted for Company approval.

- 4.1.3 A corrosion allowance as indicated in the Insulating Joint Data Sheet shall be considered in design.
- 4.1.4 Insulating joints shall not restrict the pipeline bore and shall allow free passage of scraper and instrumented pigs.
- 4.1.5 Insulating joint shall be designed to withstand a sustained internal vacuum of at least one (1) milli-bar.
- 4.1.6 The joint between pipe pup pieces and main forging shall be full penetration butt weld type. Weld design shall be such as resulting in a weld joint factor of 1.0.
- 4.1.7 Butt weld ends shall have ends prepared as per ASME B 16.25. However, end preparation for butt welding ends having unequal thickness with respect to connecting pipe, shall be as per ASME B.31.4/B 31.8 as applicable.
- 4.1.8 Insulating joints shall be suitable for aboveground or underground installation as specified in the Insulating Joint Data Sheet.
- 4.1.9 The reinforcement of inside weld seam, in case of pups fabricated from LSAW pipes, shall be removed for a distance of at least 50 mm from each end.
- 4.1.10 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall include impact test and hardness test and shall meet the requirements of Para 3.4 and 3.5 respectively of this specification.
- 4.1.11 Repair welding on parent metal is not allowed. Repair of welds shall be carried out only after specific approval by Company's Inspector for each repair. The repair welding shall be carried out by welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein. Radiography shall be performed after the weld repair.
- 4.1.12 The tolerance on internal diameter and out of roundness at the ends for Insulating joints shall be as per applicable connected pipe specification as indicated in the Data Sheet.

#### **4.2 Electrical**

- 4.2.1 The average dielectric strength of the insulating joint shall be minimum 15 KV.
- 4.2.2 Two cleats as shown in Fig. 4.1 & Fig. 4.2, shall be provided on the pups on either side of the insulating joint for connecting 10 mm<sup>2</sup> and 50 mm<sup>2</sup> cables for measurement/shorting purposes. Cleats shall be attached to the insulating joint by welding.

#### **4.3 Insulating Material**

The design of insulating material shall conform to following requirements:

- 4.3.1 The electric resistance does not decrease with time.
- 4.3.2 The insulating material shall not deform.
- 4.3.3 The insulating material shall be resistance to chemical attack by transferred fluid under design temperature and pressure.
- 4.3.4 The transferred fluid does not penetrate into the structure of the insulating material under design conditions of pressure and temperature.

#### **5.0 INSPECTION AND TESTS**

- 5.1** The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment at his Works. Such inspection and tests shall be, but not limited to, the following
- 5.1.1** All insulating joints shall be visually inspected. The internal and external surfaces shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.
- 5.1.2** Dimensional checks shall be carried out as per the Company approved drawings.
- 5.1.3** Chemical composition and mechanical properties including hardness shall be checked as per relevant material standards and this specification, for each heat of steel used.
- 5.1.4** Non-destructive inspection of insulating joints shall be carried out as given below:
- a) All butt welds and repair welds of pressure containing parts shall be examined 100% by radiography. Acceptance limits shall be as per API 1104. Welds, which in Company's opinion cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix U and Appendix VI respectively.
  - b) All forgings shall be wet magnetic particle inspected on 100% of forged surfaces. Method and acceptance shall comply with MSS-SP-53.
  - c) All finished weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the ends. Any lamination larger than 6.35 mm shall not be acceptable.
  - d) All fillet welds of thickness <6 mm shall be examined 100% by magnetic particle inspection and mm shall be examined 100% by UT. Acceptance criteria for MPI and UT shall be as per ASME Sec VIII Appendix VI and Appendix U respectively.
- 5.1.5** Insulating joints shall be hydrostatically tested to a pressure as indicated in the Insulating Joint Data Sheet. The test duration shall be 15 minutes.
- 5.1.6** After hydrostatic test, insulating joints shall be tested with air at 5 kg/cm<sup>2</sup> for 10 minutes. The tightness shall be checked by immersion or with a frothing agent. No leakage will be accepted.
- 5.1.7** Dielectric Test
- a) Insulation resistance of each insulating joint shall be at least 25 Mega Ohms, when checked with 500-1000 V DC.
  - b) In addition, prior to and after hydrotesting, each insulating joint shall be tested for dielectric integrity at 5000 V AC, 50 Hz for one minute and the leakage current before and after the hydrostatic test shall be equal. Testing time, voltage and leakage shall be recorded and certified. No repair shall be permitted to the insulating joints failed in the above mentioned tests.
- 5.2** Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 at Manufacturer's Works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection by the Company's Inspector. Inspection and tests performed/witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.
- 6.0 TEST CERTIFICATES**
- 6.1 Manufacturer shall submit following certificates to Company's inspector:**
- a. Test certificates relevant to the chemical analysis and mechanical properties of the materials used for construction of insulating joint as per this specification and relevant standards.

- b. Test reports on non-destructive testing.
- c. Test certificates for hydrostatic and air tests.
- d. Test certificate for electrical tests.

## **7.0 PAINTING, MARKING AND SHIPMENT**

**7.1** After all inspection and tests required have been carried out, Insulating joint surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint as per manufacturer's standard suitable for normal corrosive environment unless otherwise specified in the data sheets. Surface preparation shall be carried out by shotblasting to SP-10 in accordance with "Guide and Reference Photographs for Steel surfaces Prepared by Dry Abrasive Blast Cleaning SSPC-VIS-1". External surfaces of buried insulating joints shall be painted as per manufacturer's standard or as specified in data sheet. Manufacturer shall indicate the type of corrosion resistant paint used, in the drawings submitted for approval.

### **7.2 Insulating joints shall be marked with indelible paint with the following data:**

- a. Manufacturer's name
- b. Suitable for inch Nominal diameter pipeline
- c. End thickness in mm
- d. Material
- e. Design Pressure / Hydrostatic Test Pressure
- f. ANSI Class Rating
- g. Tag No.
- h. Year of Manufacture

**7.3** Insulating joints shall be suitably protected to avoid any damage during transit. Metallic or high-impact plastic bevel protectors shall be provided for weld ends.

**7.4** Only those insulating joints, which have been inspected and certified by Company's Inspector, shall be shipped.

## **8.0 DOCUMENTATION**

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

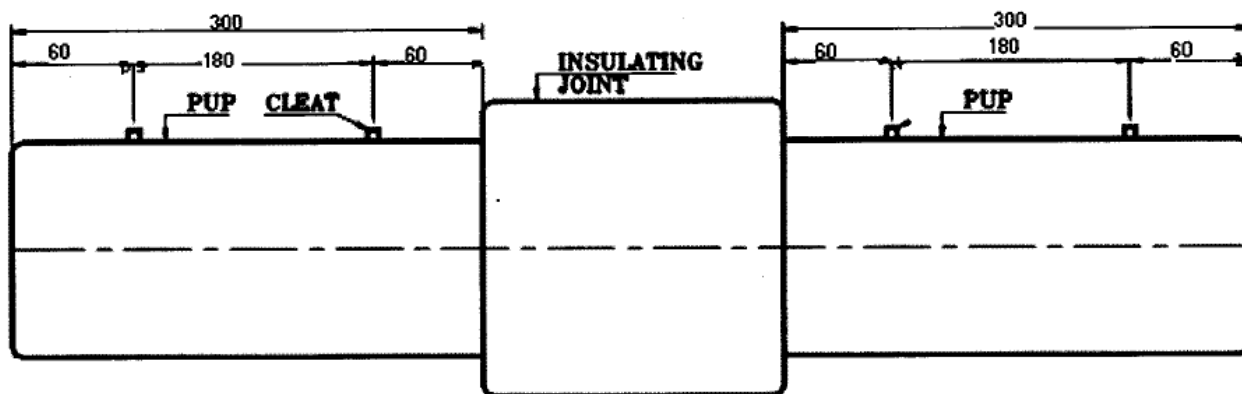
**8.1** At the time of bidding, Bidder shall submit the following documents:

- a. Reference list of similar supplies including all relevant details viz. Project, Year of supply, Client, Location, Size, Rating and Service for the last seven years

**8.2** After the placement of order, the Manufacturer shall submit the following documents for Company's information & review.

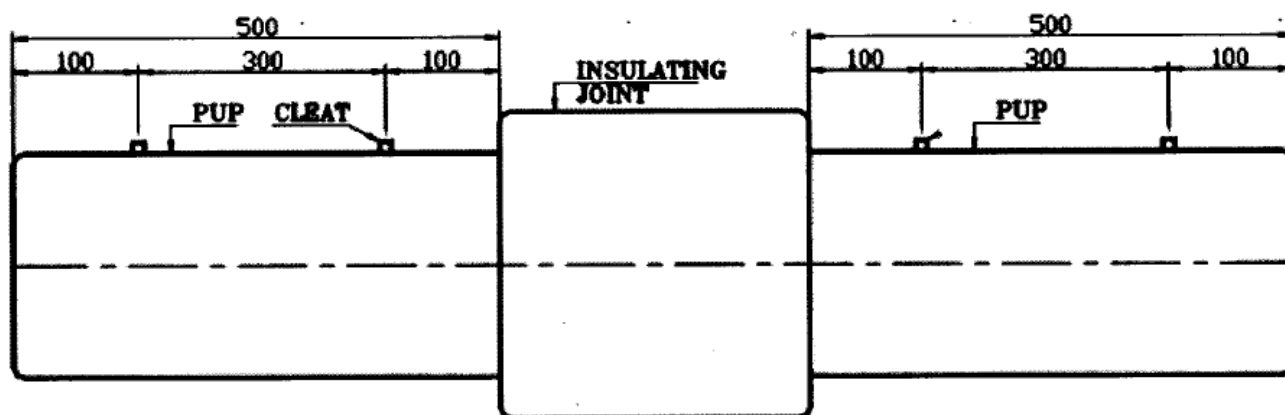
- a. General Arrangement drawing with overall dimensions and cross sectional drawings along with calculation of pressure containing parts.

**8.3** All documents shall be in English Language only.



**FIGURE - 4.1**

(For Sizes upto 8" NB)



**FIGURE - 4.2**

(For Sizes above 8" NB)



# STANDARD SPECIFICATION FOR PAINTING

SPECIFICATION NO.  
P-SPC-410

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# STANDARD SPECIFICATION FOR PAINTING

## P-SPC-410

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## **1.0 GENERAL**

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

Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor. Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

## **1.2 SCOPE**

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

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

### **1.2.3 Extent of Work**

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

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

- i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
- l. Painting of pre-erection/fabrication and Shop primer.
- m. Repair work of damaged pre-erection/fabrication and shop primer and weld joints in the field/site before and after erection as required.
- n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.

1.2.3.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials
- c. Non-ferrous materials like aluminum.

#### 1.2.4 Documents

1.2.4.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

- a. Bill of quantities for piping, equipment, machinery and structures etc.
- b. Piping Line List.
- e. Painting specifications including special civil defence requirements.

1.2.5 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

1.2.6 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to PLECO for deviation permit.

## 2.0 CODES & STANDARDS

Without prejudice to the specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS: 5 Colors for ready mixed paints and enamels.

RAL DUTCH International Standard for colour shade (Dutch Standard)

IS: 101 Methods of test for ready mixed paints and enamels,

IS: 161 Heat resistant paints.

- IS: 2074      Specifications for ready mixed paint, red oxide zinc chrome priming.
- IS: 2379      Color code for identification of pipelines.
- IS: 2932      Specification for enamel, synthetic, exterior (a) undercoating. (b) Finishing.

### **3.0 CONDITIONS OF DELIVERY**

#### **Packaging**

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

### **4.0 COMPOSITION OF THE PAINT PRODUCTS USED**

#### **a) Quality**

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

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

#### **b) Quality control - Sampling**

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

If analyses reveal a non-conformity in the composition of the products used (tolerance of  $\pm 3\%$  of the dosage of every component), the OWNER may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding the work, a product that does conform will be required. The only Purpose of the analysis is to reveal any nonconformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analyses concerned are not acceptance tests of the products supplied and in no way affect the obligations of the contractor specified in the contract towards the OWNER.

## **5.0 IDENTIFICATION**

Every recipient will bear the following information:

- Name of the manufacturer
- Date and number of manufacture
- Name of the product type
- Batch no
- Net weight of the produced or the contents of the recipient
- Date of the expiry.

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

### Leaving the site after work

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

The restoration work includes among other things:

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

## **6.0 SURFACE PREPARATION STANDARDS**

Following latest edition of standards shall be followed for surface preparations:

1. Swedish Standard Institution- SIS-05 5900-1967/ISO 8501-1
2. Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)
3. British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS-4232.
4. National Association of Corrosion Engineers. U.S.A. (NACE).
5. IS-1477-1971 (Part-1) - Code of Practice for Painting of Ferrous metals in Buildings. (Part 1, Pre-treatment)
  - a) The contractor shall arrange, at his own cost to keep a set of latest edition of above standards and codes at site.
  - b) The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure as well as extremes of temperature.
  - Surface preparation prior to painting.
  - Mixing and thinning.
  - Application of paints and the recommended limit on time intervals between coats.
- c) Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the OWNER, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

## **7.0 PREPARATION OF THE SURFACES**

### **7.1 General Specifications**

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

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

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

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

Based on the environmental conditions of coastal and saline nature, the Painting specification for station pipes defines the complete requirements like:

- Surface preparation standards like NACE etc.
- Sand blasting process
- Color Codes for piping
- Paint materials types and their DFT measurement.
- Selection and application of paints on external surfaces.

The pipeline passes through the coastal and marine environment, the **Table-4** of this specification to be followed for the painting works.

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

- Bright blast-cleaning
- Mechanical or Power tool cleaning
- Manual or hand tool cleaning

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

## 7.2 Air blast cleaning with abrasive

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

- Clear the steel surface of oil and/or grease;
- Ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- Check that no blasting grains can act into the pipes during this process. Any openings not sealed off must be screened off;
- Where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again.
- Screen off all non-metal structures such as rubber where there is a filter;
- With valves, operators and other devices, care should be taken to ensure that no metal filings or paint get into the apparatus;
- The OWNER reserves the right to carry out part or all of these works himself.

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

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choice of the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted.

The abrasive to be used must conform to the local law i.e. it may contain no carbon and less than 1% free silicon dioxide. The Sa 3 will always be requested and must at least reach Sa 2½ during the initial stage of the paintwork. For blasting followed by metallization, the surface preparation degree to be achieved is always Sa 3. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard SVENSK STANDARD ISO 8501-1-1988 SIS 05.5900.

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

The blast-cleaning will be carried out by means of compressed air free of water and oil.

After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

## 7.3 Mechanical or Power tool cleaning

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

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

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the OWNER representative prior to the start of the works.

N.B:

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

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

#### 7.4 Manual or Hand tool cleaning

Manual derusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation there from must be requested from the OWNER/ OWNER 's Representative.

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

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

This layer is in general applied by the manufacturer, for example, on valves, regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D 3359, method A (Standard Test Method for measuring adhesion by tape test). The adhesion should be at least.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts it in the state in which the coating is found and the guarantee remains in force. The adhesion does not have to be examined if system 63 has already been applied in the workshop on behalf of the OWNER.

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

##### a) Galvanized surface

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

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

b) Metallized surfaces treated with an impregnation layer

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

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

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

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

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

7.7 Preparation of concrete or cement plaster surfaces

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

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

7.8 Use of solvents

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

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

**7.9 Condition of the metal after stripping**

The Contractor must call in a representative of the OWNER/OWNER's representative or of the Approved supervisory Body responsible for checking the condition of the metal during stripping and informing the OWNER/OWNER's representative immediately of any damage that he might have noticed.

- Deep corrosion of the plates - rivets - bolts
- Faulty welding
- Fittings that appear to be dangerous because of their age.

**7.10 Removing coating from surface pipelines**

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

**TABLE-1 (FOR CLAUSE 7.0)  
SURFACE PREPARATION STANDARDS**

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning  Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	-	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning  Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	-	
3	Dry abrasive Blast cleaning  There are four common grades of blast cleaning				

3.1	<p>White metal</p> <p>Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint &amp; foreign matter 100% cleanliness with desired surface profile.</p>	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	<p>Near white metal</p> <p>Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.</p>	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	<p>Commercial Blast</p> <p>Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.</p>	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	<p>Brush-off Blast</p> <p>Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint &amp; foreign matter. Surface profile is not so important.</p>	SA 1	SSPC-SP-7	NO.4	

## 8.0 METALLISATION

### 8.1 Applying the metallization

Metallization must be carried out in accordance with ISO 2063,

Metallization is carried out as rapidly as possible after blasting in order to limit corrosion of the pipes (max. 3 hours later). With metallization, a surface preparation degree Sa 3 is compulsory. The roughness of the blasted surfaces should be from 25 to 50µ R<sub>Max</sub>.

- The metallizing is always carried out on dry parts in good weather conditions (maximum relative humidity 80 %);
- For metallization, a wire composed of 85 % zinc and 15 % aluminum with a minimum guaranteed degree of purity of 99.5 % is used (subject to other specifications). The application thereof is always carried out in accordance with the conditions of the manufacturer and may at all times be submitted to the OWNER's representative.
- The sealant should be applied maximum 3 hours after metallization.
- The sealant must be thinned and applied as per the present specifications. A visual inspection whereby the sealant completely covers the metallization will suffice here.
- When evaluating the metallization, a negative deviation from the minimum coating thickness, to 80  $\mu$  for 20% of the measurements will be permitted.

## **9.0 COATING PROCEDURE AND APPLICATION**

### **9.1 Conditions for carrying out paintwork**

Painting may not be carried out in unsuitable conditions.

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

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

The work must be stopped:

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

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

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

The first coat of paint must be applied maximum 3 hours after the preparation of the surface if the relative humidity of the air is between 50% and 80%. This time span may be increased to 6 hours if the relative humidity is less than 50%. In all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2 ½ at the time of painting.

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

## 9.2 Special conditions

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

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

The Contractor must in this respect be able to produce the instructions for the paint on the site. The OWNER/CONSULTANT will guarantee 100% supervision in this regard during the execution of the work.

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

## 10.0 PAINT MATERIAL

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Primer and finish coats shall be of class-I quality and shall conform to the following:

### a) Primer (P-1)

Red oxide Zinc Chromate Primer

Type and Composition	Single pack, Modified phenolic alkyd medium pigmented with red oxide and zinc chromate.
Volume solids	30 - 35% (min)
DFT	25 microns/coat (min)
Covering capacity	12 - 13 M <sup>2</sup> /Lit/coat

### b) Primer (P-2)

High build chlorinated rubber zinc phosphate primer

Type and Composition	Single pack, Air Drying Chlorinated rubber medium Plasticized with unsaponifiable plasticiser pigmented with zinc phosphate
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	Volume solids	35 - 40% (min)
	DFT	30 - 40 microns/coat (min)
	Covering capacity	7 - 8 M <sup>2</sup> /Lit/Coat
c)	Primer (P-3)	
	High build zinc phosphate primer	
	Type and Composition	Single Pack, Synthetic medium, pigmented with zinc phosphate.
	Volume solids	40 - 45% (min)
	DFT	35 - 50 microns/coat (min)
	Covering capacity	10 - 12 M <sup>2</sup> /Lit/coat
	Heat resistance Upto 80 °C (dry)	
d)	Primer (P-4)	
	Etch Primer / Wash Primer	
	Type and Composition	Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
	Volume solids	7 - 8% (min)
	DFT	8 - 10 microns/coat (min)
	Covering capacity	7 - 8 M <sup>2</sup> /lit/coat
e)	Primer (P-5)	
	Epoxy Zinc Chromate Primer	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium pigmented with zinc chromate.
	Volume solids	40 % (min)
	DFT	35 microns/coat (min)
	Covering capacity	11 - 12 M <sup>2</sup> /lit/Coat
f)	Primer (P-6)	
	Epoxy Zinc Phosphate Primer	
	Type and Composition	Two packs, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.
	Volume solids	40% (min)

	DFT	35 - 50 microns/coat (min)
	Covering capacity	11 - 12 M <sup>2</sup> /lit/coat
g)	Primer (P-7)	
	Epoxy high build M10 Paint (Intermediate Coat)	
	Type and composition	two pack Poly Polyamide cured epoxy resin medium pigmented with micaceous iron oxide. Volume solids 7- 8%
	Volume Solids	50% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.0 M <sup>2</sup> /lit/coat
h)	Primer (P-8)	
	Epoxy Red Oxide zinc phosphate primer	
	Type and Composition	two pack. Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.
	Volume solids	42% (min)
	DFT	30 microns/coat (min)
	Covering capacity	13 - 14 M <sup>2</sup> /lit/coat
i)	Primer (P-9)	
	Epoxy based tie coat (suitable for conventional alkyd based coating prior to application of acrylic polyurethane epoxy finishing coat)	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium suitably pigmented.
	Volume solids	50 - 60% (min)
	DFT	50 microns/coat (min)
	Covering capacity	10 - 12 M <sup>2</sup> /Lit/Coat
j)	Finish Coats (F-1)	
	Synthetic Enamel	
	Type and Composition	Single pack, Alkyd medium pigmented with superior quality water and weather resistant pigments
	Volume solids	30 - 40% (min)
	DFT	20 - 25 microns/coat
	Covering capacity	16 - 18 M <sup>2</sup> /lit/Coat
k)	Finish coat (F-2)	

## Acrylic Polyurethane paint

Type and Composition	Two pack, Acrylic resin and iso-cyanate hardener suitably pigmented.
Volume Solids	40% (min)
DFT	30 - 40 microns / coat
Covering Capacity	10 - 12 M <sup>2</sup> /lit/ coat

### l) Finish Coat (F-3)

## Chlorinated Rubber Paint

Type and Composition	Single pack, Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
Volume solids	40% (min)
DFT	30 - 40 microns/coat (min)
Covering capacity	8 - 10 M <sup>2</sup> /lit /coat

### m) Finish Coat (F-4)

## High build chlorinated rubber M10 paint.

Type and Composition	Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.
Volume solids	40 - 50% (min)
DFT	65 - 75 microns/coat
Covering capacity	6.0 - 7.0 M <sup>2</sup> /lit/coat

### n) Finish coat (F-5)

## Chemical Resistant Phenolic based Enamel

Type and Composition	Single pack phenolic medium suitably pigmented.
Volume solids	35 - 40% (min)
DFT	25 microns/ coat
Covering capacity	15.0 M <sup>2</sup> /lit/coat

### o) Finish Coat (F-6)

## Epoxy High Building Coating

Type and Composition	Two pack. Polyamide-amine cured epoxy resin medium suitably pigmented.
Volume solids	60 - 65% (min)

	DFT	100 microns/coat (min)
	Covering capacity	6.0 - 6.5 M <sup>2</sup> /lit/coat
p)	Finish Coat (F-7)	
	High build Coal Tar Epoxy	
	Type and Composition	Two pack, Polyamine cured epoxy resin blended with Coal Tar.
	Volume solids	65% (min)
	DFT	100 - 125 microns/coat
	Covering capacity	6.0 - 6.5 M <sup>2</sup> /lit/coat
q)	Finish Coat (F-8)	
	Self-priming epoxy high build coating (complete rust control coating)	
	Type and Composition	Two packs. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manually prepared surface and old coatings.
	Volume solids	65 - 80% (min)
	DFT	125 - 150 microns/coat
	Covering capacity	4 - 5 M <sup>2</sup> /lit/coat
r)	Finish Coat (F-9)	
	Inorganic Zinc Silicate coating	
	Type and Composition	Two packs, self-cured solvent based inorganic zinc silicate coating.
	Volume solids	60% (min)
	DFT	65 - 75 microns/coat
	Covering capacity	8 - 9 M <sup>2</sup> /lit/coat
s)	Finish coat (F-10)	
	High build Black	
	Type and Composition	Single pack. Reinforced bituminous composition phenol based resin.
	Volume solids	55 - 60% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.5 - 6.0 M <sup>2</sup> /lit/coat

t) Finish Coat (F-11)

Heat Resistant Aluminium Paint Suitable up to 250°C.

Type and Composition	Dual container (paste & medium). Heat resistant spec varnish medium combined with aluminium flakes.
Volume solids	20 - 25% (min)
DFT	20 microns/coat (min)
Covering capacity	10 - 12 M <sup>2</sup> /lit/coat

u) Finish Coat (F-12)

Heat Resistant Silicon Paint suitable up to 400° C.

Type and Composition	Single pack Silicone resin based with aluminium flakes.
Volume solids	20 - 25% (min)
DFT	20 microns/coat (min)
Covering capacity	10 - 12 M <sup>2</sup> /lit/coat

v) Finish Coat (F-13)

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

Type and Composition	Single Pack, Synthetic medium rubber medium combined with leafing Aluminium,
DFT	25 microns/coat (min)
Covering capacity	9.5 M <sup>2</sup> /lit/coat

**Notes:**

- 1 Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation quality and workmanship should be ensured.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,
- 4 All primers and finish coats should be cold cured and air-drying unless otherwise specified.
5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.
7. In case of F-6, F-9, F-1 1 & F-1 2 Finish Coats, No Primer are required.

## **11.0 MANUFACTURERS**

The paints shall conform to the specifications given above and Class-I quality in their products range of any of the-following manufacturer or other approved vendors:

- i) Asian Paints (India) Ltd.
- ii) Bombay Paints
- iii) Berger Paints India Ltd.
- iv) Akzo Nobel
- v) Jenson & Nicholson
- vi) Shalimar Paints

### **STORAGE**

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by OWNER/ OWNER 's Representative for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent, building.

A signboard bearing the words given below shall be clearly displayed outside:  
PAINT STORAGE No NAKED LIGHT highly -inflammable

## **12.0 COLOR CODE FOR PIPING:**

- i) For identification of pipelines, the color code as per Table -1 shall be used.
- ii) The color code scheme is intended for identification of the individual group of the pipeline. The system of color coding consists of a ground color and color bands superimposed on it.
- iii) Colors (Ground) as given in Table-2 shall be applied throughout the entire length of un insulated pipes, on the metal cladding & on surfaces. Ground color coating of minimum 2m length or of adequate length not to be mistaken as color band shall be applied at places requiring color bands. Color bands shall be applied as per approved procedure.
- iv) Line coating shall meet DIN 30670 standard for external coating and API 5L RP – 2 for internal coating.
- v) The thickness for the epoxy should be 180 microns, adhesive 200 microns and balance should be PE .
- vi) The minimum coating thickness on weld seam shall be 3.2 mm and minimum coating thickness on body should be 3.2.
- vii) Minimum thickness for liquid epoxy for internal coating should be  $100 \pm 20$  microns.  
Max design temperature for coating should be considered +80 °C.

### **COLOR CODE:**

- A) Ball Valve (Above Ground) : Off White
- B) Globe Valve (Above Ground) : Oxford Blue-RAL 5005, IS-519941005

- C) Check Valve(Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- D) Launcher / Receiver : Yellow Golden
- E) Jib Crane / Trolley : Yellow Golden
- F) All underground valves shall have epoxy base coating after surface finish of SA 2:5
- G) Valves and above ground pipes need to be properly blasted to achieve surface finish of Sa 2:5 before the application of paints.

**Table 12.1 Colour Coding Scheme for Pipes and Equipment**

Sl. No.	Description	Ground Color	First Color Band	Second Color Band
1	<b>COMPRESSED AIR</b>			
a)	Plant Air	Sky Blue	Silver Grey	-
b)	Instrument Air	Sea Green	Black	-
2	<b>GASES</b>			
a)	Charge Gas	Canary Yellow	Signal Red	Smoke Grey
b)	Regeneration Gas	Canary Yellow	White	Dark Violet
c)	Residue Gas	Canary Yellow	White	French Blue
d)	LPG	Canary Yellow	Brilliant Green	White
e)	Acetylene	Canary Yellow	Dark violet	-
	Flare Lines	Heat resistant aluminium		
f)	Fire water and Foam & Extinguisher	Post office red		
3	<b>ALL EQUIPMENT</b>			
a)	Vessels. Columns, exchangers, etc. containing non- hazardous fluids.	Light Grey		
b)	Base Frame/Structure	Black		
b)	All equipment containing hazardous fluids	Canary Yellow		

c)	Pipe carrying hazardous fluids	Bar is to be replaced by Hazardous Marking as per IS:2379 Clause 7.1C		
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## IDENTIFICATION SIGN

- i) Colors of arrows shall be black or white and in contrast to the color on which they are superimposed.
- ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by OWNER.
- iii) Size of arrow shall be either of the following:

- a) Color Bands

Minimum width of color band shall be as per approved procedure.

- b) Whenever it is required by the OWNER to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden, yellow as per IS:2379 shall be painted on the ground color.

## IDENTIFICATION OF EQUIPMENT

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

## INSPECTION AND TESTING

1. All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates Paint formulations without certificates are not acceptable.
2. The painting work shall be subject to inspection by OWNER/ OWNER's Representative at all times. In particular, following stage wise inspection will be performed and contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage.

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

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of OWNER/ OWNER's Representative before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work. Contractor shall be responsible for

making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER.

#### PRIMER APPLICATION

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

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

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

## 18.0 PAINT SYSTEMS

The paint system should vary, with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

- a) Normal Industrial Environment, Table 18.2.
- b) Corrosive industrial Environment, Table 18.3
- c) Coastal & Marine Environment, Table 18.4

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

**TABLE 18.1: LIST OF PRIMERS & FINISH PAINTS**

<b>PRIMERS</b>	
P-1	Red oxide Zinc chromate Primer
P-2	Chlorinated rubber zinc Phosphate Primer
P-3	High build Zinc phosphate Primer
P-4	Etch Primer/Wash Primer
P-5	Epoxy Zinc Chromate Primer

P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardener
P-8	Epoxy red oxide zinc phosphate primer
<b><u>FINISH COATS / PAINTS</u></b>	
F-1	Synthetic Enamel
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-5	Chemical resistant phenolic based enamel
F-6	High Build Epoxy finish coating cured with <b>polyamide</b> hardener
F-7	High build Coal Tar Epoxy coating cured with <b>polyamine</b> hardener
F-8	Self priming surface Tolerant High Build epoxy coating. cured with <b>polyamine</b> hardener
F-9	Two component Inorganic Zinc Silicate coating
F-10	High build Reinforced bituminous composition phenol based resin.
F-11	Heat resistant synthetic medium based Aluminium paint suitable for 250 deg C
F-12	Two component Heat resistant Silicone Aluminium paint. suitable for 400 deg C
F-13	Synthetic based aluminium Paint suitable for 150 deg C

**Table – 18.2: Painting System for Normal Industrial Environment for Piping and Equipment (Above Ground)**

Sl. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-10 to 20	SSPC-SP-3	One coat P-2 50 microns / coat (min)	One coat F-4 65 microns/ coat (min) Two coats F-3, 30 Microns/coat (min)	175	Primer and Finish coat can be applied at ambient temp.
2	21 to 60	SSPC-SP-6	Two coats P-1, 25 microns/ coat (min.)	Two coats of F-1, 20 microns/coat (min)	90	-
3	61 to 80	SSPC-SP-6	Two coats P-3, 50 microns/ coat (min)	Two coats of F-13, 25 microns/coat (min)	150	-
4	81 to 250	SSPC-SP-6	-	Three coats of F-11, 20 microns/ coat (min)	60	Paint application at ambient temp. curing at elevated temp. during start-up.
5	251 to 400	SSPC-SP-10	-	Three coats of F-12, 20 microns/ coat (min)	60	-do-

**Table – 18.3: Painting System for Corrosive Industrial Environment for Piping and Equipment (Above Ground)**

Sl. No.	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6, 35 microns / coat (min.)	One coats F- 6, 100 microns coat (min.) and one coats F- 2 40 microns coat (min.)	210	Paint application at ambient temp.

2	81 to 250	SSPC-SP-10	-	Three coats F-11, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours
3	81 to 400	SSPC-SP-10	-	Three coats F-12, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours

**Table – 18.4 : Painting System for Coastal and Marine Environment for Piping and Equipment (Above Ground)**

Sl. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6. 35 Microns. coat (Min.)	Two coats F-6, 100 microns /coat (min.) and one coats F-2 40 Microns /coat (min.)	310	Primer and Finish coat application at Ambient temp.
2	81 to 400	SSPC-SP-10	-	- Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours
3	401 to 550	SSPC-SP- 10	-	Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours

**Table – 18.5 : Painting System for External Side of Underground Tanks in all areas.**

Sl. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
External side of un-insulated underground storage tanks:						

1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75 $\mu$ DFT/ coat	3 coats of F-7 @ 100 $\mu$ DFT/coat (3x100=300)	365-375	
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## 18.2 Precautions to be taken

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

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

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

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

## 18.3 Method of application

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

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

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

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

## 18.4 Application of the coating

Application of the paint will be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The OWNER or the Approved Supervisory body demands that

painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

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

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

The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the OWNER or the Approved Supervisory Body.

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

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

#### 18.5 Transporting treated items

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

### 19.0 GROUND-LEVEL TRANSITION POINT

#### 19.1 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 20 cm and a depth of 40 cm. perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over the entire surface area, prepared in accordance with is Sa 3:

- 1) The primer of system 01.
- 2) Reinforced polyester  $\pm$  20 cm above the ground level marker and  $\pm$  5 cm on the asphalt cleaned beforehand (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the case of PE, in contrast to asphalt, he will apply a polygon primer to PE immediately before applying the reinforced polyester.
- 3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.

- 4) For new constructions, the polygon primer will be applied to PE and then subsequently processed as described under point 2.

## **20.0 USE OF SCAFFOLDING**

Mounting, maintenance and dismantling of scaffolding for carrying out adaptation and/or paintwork to surface gas pipes or gas transport installations in use;

- The Contractor will specify the cost of scaffolding in the price list.
- The supplementary rental price for delays attributable to the Contractor will be charged to him:
- In his price quotation the Contractor should present the OWNER with diagrams of the scaffolding that he intends to install for carrying out the works of the OWNER.

## **21.0 QUALITY CONTROLS AND GUARANTEE**

- 21.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications.

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

The OWNER or his representative and possibly the approved supervisory body indicated by the OWNER will maintain supervision during the works and inspect the works with random checks. A daily report will be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the OWNER or the approved supervisory body do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

- 21.2 Reference Surfaces

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

- 21.3 Measures to be taken in the event of a dispute

If on delivery of the works no agreement can be reached between the Contractor and the OWNER regarding the conformity of the works to the requirements of these specifications, an Approved Supervisory Body will be Called in. The Approved Supervisory Body will then carry out inspections' on site whereby the following assessment criteria will be used:

- The Swedish standards ISO 8501-1 1988 SS 05.5900 concerning the degree of cleanliness of the areas derusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 or ASTM D 1212;
- The dry layer thickness of the film will be measured electronically, will complete statistical information. in accordance with, ISO 2808 or ASTM D 1186.
- The thickness of each layer will be measured in accordance with ISO 2808. ASTM 4138 or DIN 50986.
- 
- Adhesion tests will be carried out in accordance with ISO 2409. ASTM 3359 or DIN 53151.
- Traction tests will be carried out in conformity with ISO 4624 or ASTM D 4541.
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer.
- Any defects in the paint film may be inspected visually by means of a magnifying glass or microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82.

The final judgment of the Approved Supervisory Body is irrevocable and binding for the Contractor and the OWNER. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by the Approved Supervisory Body shall be borne by the Contractor.

#### 21.4 Guarantee

##### a) General Principles

The Contractor declares that he is aware of:

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

##### b) Summary of the Guarantee.

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paintwork regarding, among other things:

- The preparation of the surfaces.
  - The thickness of each layer.
  - The total thickness of the covering.
- The uniformity of the materials used.
- The repair of all defects before delivery of the works.

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



**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**

0	31.12.2021	ISSUED AS STANDARD SPECIFICATION	RK	MD	AD	SK
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by

## 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		

## 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
<b>HFW</b>	Thermomechanical-rolled coil	Cold forming	Heat treating <sup>a</sup> of weld area only	<b>M</b>
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 Joints

8.11.1 Joints 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**

Element	Mass Fraction based on Heat and Product Analyses (%)	
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.
Mn <sup>b</sup>	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.

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 <sub>PCM</sub> limits apply if C < 0.12% and CE <sub>IW</sub> limits apply if C > 0.12%. For pipes of all grades, sizes and wall thicknesses, Carbon Equivalent shall comply with the following limits: CE <sub>PCM</sub> ≤ 0.20 % CE <sub>IW</sub> ≤ 0.40 % Boron content shall be considered in CE <sub>PCM</sub> 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
<p>a The pipe end includes a length of 100 mm at each of the pipe extremities.</p> <p>b Deleted.</p> <p>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 <math>ID = (D - 2t)</math>.</p> <p>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 <math>\pi (x)</math>.</p> <p>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.</p>				

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

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.

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

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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 <sup>d</sup>	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	
a See figure 5 (b) of API Specification 5L for an explanation of the symbols used to designate orientation and location.			
b Test specimen shall be tested for ultimate tensile strength only.			

**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.

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.

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.

**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**

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 <math>\pm 15\%</math> of the specified notch depth or <math>\pm 0.05</math> 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 LAMINAR 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>						

**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]	
	<i>Average</i>	<i>Minimum</i>
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>		

**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**

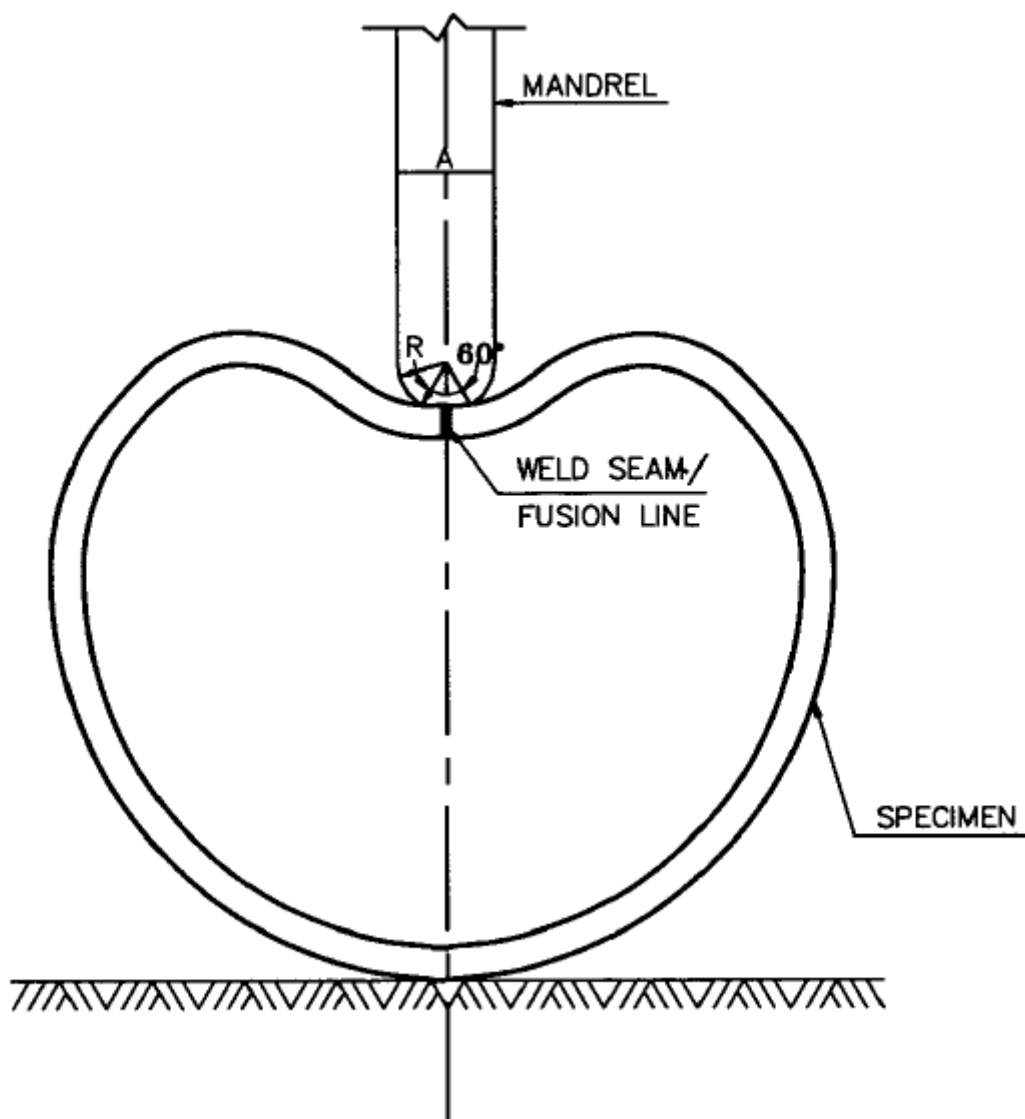
The inspector representing the purchaser shall have unrestricted access, at all times while work of the contract of the purchaser is being performed, to all parts of the manufacturer's works that will concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector all reasonable 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**

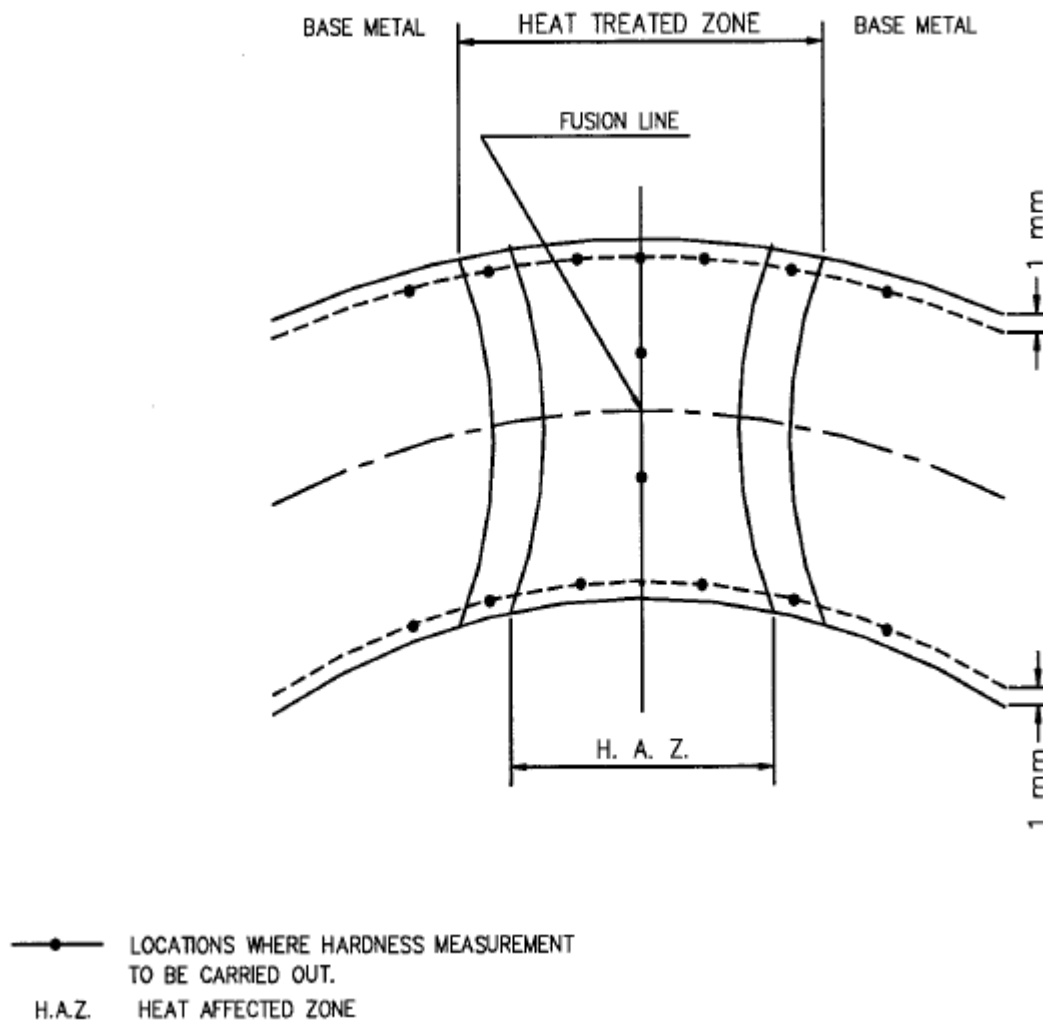
The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to be satisfied of compliance by the manufacturer and any reject any material that does not comply with this specification.

**Q.4 REJECTION**

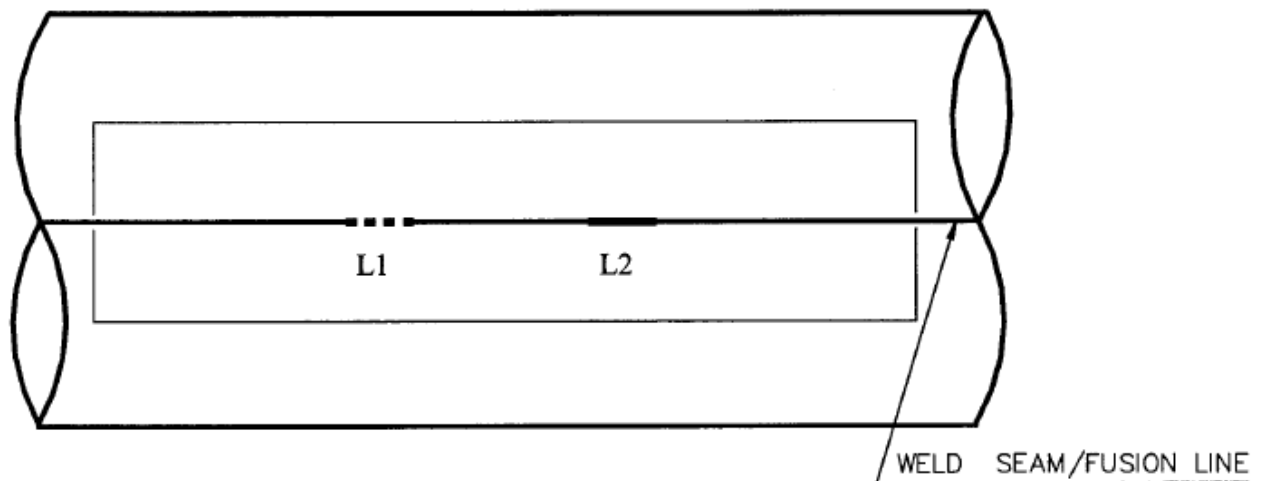
If the Purchaser Representative rejects pipes repeatedly for any recurring cause, this shall be adequate reason to refuse final inspection of subsequent pipes until the cause has been investigated and corrective action taken by the Manufacturer.



**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**



## INSPECTION AND TEST PLAN FOR INSULATING JOINTS

DOCUMENT NO.  
**P-ITP-005**  
Page 1 of 6

# INSPECTION AND TEST PLAN FOR INSULATING JOINTS

0	04.01.22	ISSUED AS INSPECTION AND TEST PLAN	PNS	MD	AD
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by



## INSPECTION AND TEST PLAN FOR INSULATING JOINTS

DOCUMENT NO.

P-ITP-005

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### ABBREVIATIONS:

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



## INSPECTION AND TEST PLAN FOR INSULATING JOINTS

DOCUMENT NO.

P-ITP-005

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### 1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Insulating Joints.

### 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	PLECO/TPIA
1.0	Procedure						
1.1	NDT Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure Documents	-	H	R-Existing W-New
2.0	Material Inspection						



## INSPECTION AND TEST PLAN FOR INSULATING JOINTS

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SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	PLECO/TPIA
2.1.	Fittings, Forged Ring, Gasket, Pipe, Insulating Ring, Filling Material, etc.	Chemical / Mechanical Properties, NDT, HT and other requirement as per purchase specification.	100%	MTC & Inspection Record	H	H	R
<b>3.0</b>	<b>In Process Inspection</b>						
3.1	Welding	Welding Parameters, NDT (as applicable)	100%	NDT Records/RT films	-	W	R
<b>4.0</b>	<b>Final Inspection</b>						
4.1	Hydro Testing, Air Leak test, Vacuum test (As applicable)	Leak Check	100%	Test Report	-	H	H
4.2	Visual and Dimension Check	Visual and Dimension Check	100%	Inspection Report	-	H	RW



# INSPECTION AND TEST PLAN FOR INSULATING JOINTS

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SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	PLECO/TPIA
4.3	Dielectric Test	Insulating Resistance	100%	Inspection Report	-	W	RW
<b>5.0</b>	<b>Painting</b>						
5.1	Final painting (as applicable)	Paint Scheme, Visual & Paint thickness check	100%	Inspection Report	-	H	-
<b>6.0</b>	<b>Documentation &amp; IC</b>						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	-	-	H



## INSPECTION AND TEST PLAN FOR INSULATING JOINTS

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SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	PLECO/TPIA
6.2	Review of final documentation	Compilation of documents as per VDR attached with PR records for submission to customer	100%	Dossier/Completion certificate	-	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 items)],

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).



## 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"/>

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

## 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**

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



## DRAWINGS & DOCUMENTS

DOCUMENT NO.  
P-STD-005

### 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.

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



## 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

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



## REFERENCE LIST

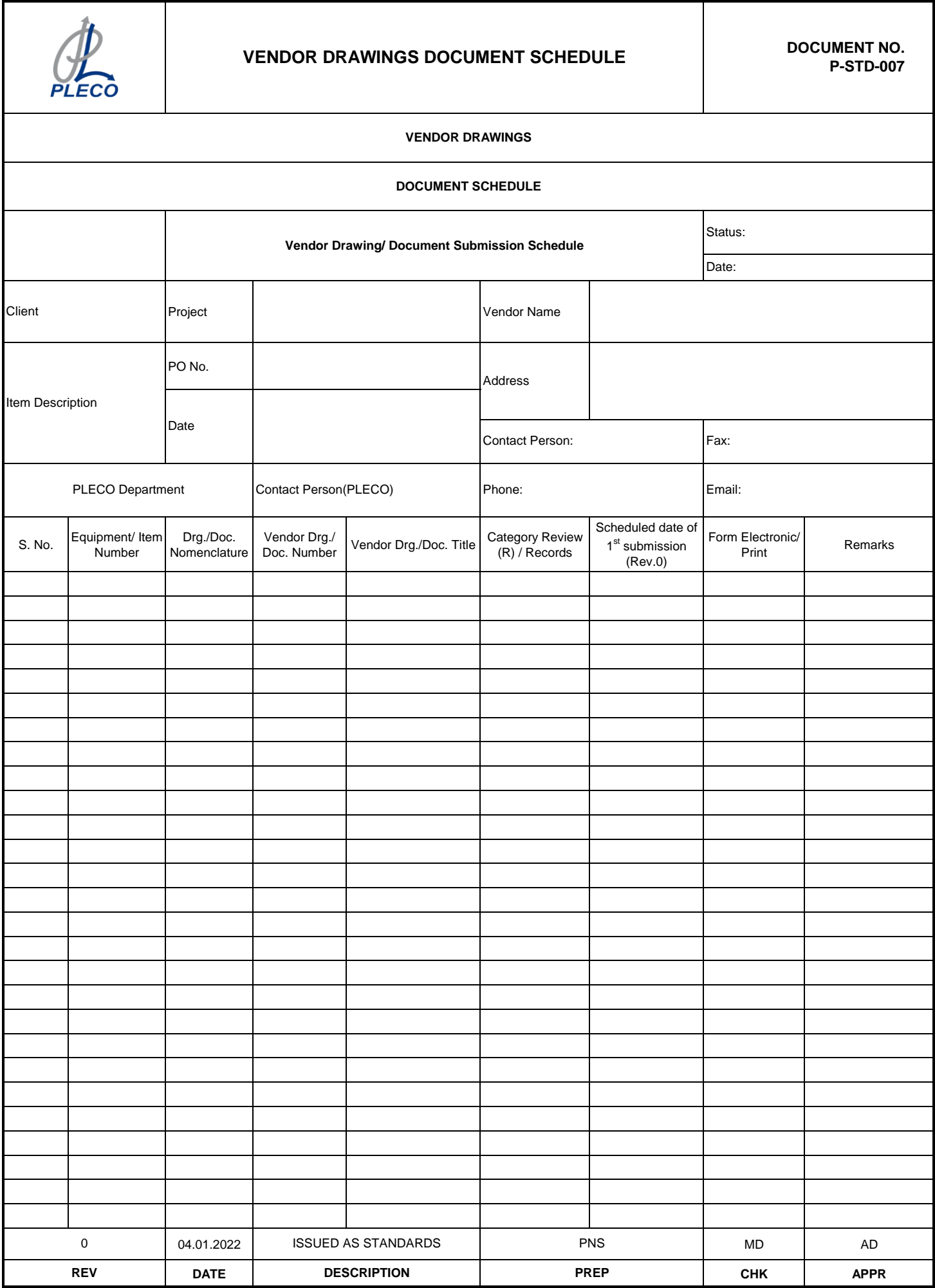
DOCUMENT NO.  
P-STD-002

### REFERENCE LIST

SI No.	Project	Year of Supply	Client , Address and Contact No.	Email	Size and Rating/ thk	Service

Bidder's Signature with stamp

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



	<b>LIST OF RECOMMENDED THIRD PARTY INSPECTION AGENCY (TPIA)</b>			
	<b>CONSULTANT:</b>	<b>Pipeline Engineering Consultants Private Limited (PLECO)</b>		
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,Ahmedabad-380006	079-26575550	079-6575558
7	International Certification Systems	E-7,Chand Society, Juhu Road, Juhu, Mumbai-400049	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 : <a href="http://www.meenaar.in">www.meenaar.in</a> Email : <a href="mailto:nitin.taneja@meenaar.in">nitin.taneja@meenaar.in</a>
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