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K.P.V			Reproduced from Rev 2 and issued for Bid	17	12-01-05	2
B.P.M			Reproduced from Rev 2 and Issued for Bid	17	10.5.04	2
	A.K.S.	V.K.K.	REVISED & REISSUED	17	01.12.2003	2
A.K.M.			RE-PRODUCED FROM REV.1 & ISSUED FOR BID	17	23.7.03	1
A.K.S		V.K.K.	REVISED & RE- ISSUED FOR BID	21	15.5.97	1
			ISSUED FOR BID	21	17.12.90	0
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1.0 SCOPE

This specification describes the technical requirements for the performance of all operations and incidental works related to pre- engineering / pre-construction and post-construction surveys of the submarine pipeline to be laid. The submarine pipelines to be laid are given in the bid document elsewhere.

The proposed pipeline route is indicated in the enclosed field layout drawing and pipeline route survey drawing. The drawings are enclosed in Part IV of the bid package.

The surveys shall cover the corridor along the proposed pipeline alignment and location survey of existing pipelines. The proposed route is crossing over a few lines and runs as indicated in field layout drawing.


The pre-engineering / pre-construction route surveys shall consist of minimum 3 longitudinal lines, with one line along pipeline and two wing lines 200 m apart on either side of proposed pipeline route incorporating side scan sonar, sub-bottom profiler, echo-sounder, magnetometer, shallow soil sampling and associated positioning system. The side scan sonar shall be operated on 150 m range giving a minimum 100 m overlap between lines. Transverse lines for full swath (700 m) shall be run at 500 m intervals to cover the existing pipeline with in proposed pipeline corridor. The configuration shall be as per the drgs. enclosed with this specification.


In addition, sector-scan sonar/video recorder shall be used to delineate existing pipeline at platform and crossings.


The post-construction survey of the installed pipeline system shall be carried out with all the above-mentioned equipment and matching configuration and geodetic controls as used in the pre-engineering surveys.


The work shall include furnishing of all personnel, materials, equipment and tools etc. necessary for carrying out the complete work as described herein.


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<p>As used in this specification, the following definitions shall apply :</p> <p>Company : OIL AND NATURAL GAS CORPORATION LTD.</p> <p>Contractor : SURVEYOR/INSTALLATION CONTRACTOR/ TRUNKY CONTRACTOR</p> <p>The Contractor shall obtain Company's written approval for any deviation from the requirements of this specification and the drawings referenced herein.</p> <p>This document is not intended to be all inclusive and the use of the guidelines set forth does not relieve the Contractor of his responsibility to collect and furnish survey data capable of providing the requirement inputs for planning, designs, engineering and application.</p> <p>The pipeline route to be surveyed shall be developed from the field layout enclosed and shall be submitted for Company approval along with route alignment co-ordinates, section lengths and directions etc.</p> <p>During survey, the work reports attached at the end of this specification shall be filled in by the Contractor and signed by the Contractor and Company's Representative.</p> <p>2.0 PREPARATION FOR THE SURVEY WORK</p> <p>Prior to the beginning of the survey work, Contractor's Chief Surveyor, responsible for the management and execution of the entire job, shall plan the complete work with the Company/Company's Representative.</p> <p>The Chief Surveyor shall then prepare a procedural document indicating as a minimum the following :</p> <ol style="list-style-type: none"> Proposed equipment including vessels with all requisite details. Sequence/location of profiles <p>Geodetic controls and horizontal control of survey</p>				
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<p>c. Location of soil samples etc.</p> <p>d. Instrument calibration procedures</p> <p>e. Survey Schedule</p> <p>Contractor shall ensure incorporation of all Company's comments before submission of final survey.</p> <p>SCHEDULE</p> <p>Daily work sheets indicating the length of profiles, type of equipment and/or sampling operations shall be maintained. These records shall be included in the final report submitted to the Company.</p> <p>Preliminary interpretation of the side-scan, sub-bottom profiler and echo sounder records shall be performed on board to delineate the existing pipeline, and to assess the acceptability of each of the pipeline routes. No delays will be accepted for this reason, as this preliminary interpretation should be performed almost simultaneously with the recording and completed within 24 hours after completion of the surveys.</p> <p>The Company shall have the option to designate its engineer(s) to supervise the data collection and interpretation on board. The vessel shall have suitable accommodation for at least 3 Company's Representatives.</p> <p>3.0 POSITIONING SYSTEM AND COMMUNICATION</p> <p>The Contractor shall install a horizontal positioning system capable of giving the location of the ship with less than 2-meter error. This system shall be able to work continuously 24 hours per day. Vessels shall have a permanent link with the Company's shore base, by means of radio network, to inform the progress of the work at any time. This system shall not cause interference with the above positioning system. Radio communication describing daily work shall be established periodically minimum once every day with the Company's Base.</p>				
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<p>The layout and UTM/geographical (Everest 1830) co-ordinates of the pipeline terminal points are given in the referenced drawings. Accurate positioning of pipeline terminal points shall be the Contractor's Responsibility.</p> <p>4.0 MARINE SURVEY</p> <p>The marine survey includes all operations required to obtain the bathymetry, morphology of the sea bottom and shallow geology as described herein.</p> <p>All works required to install and operate the survey ship positioning system are also included. The width of the corridors to be investigated shall be 700 m which shall comprise new pipeline to be installed and existing pipelines, if any. The survey area includes the platform area from where the pipelines originate/terminate and a corridor along the pipeline routes. The platform area and the pipeline route should be investigated by means of 3 (three) longitudinal profiles run at 200 meter spacings with 700 m long transverse profiles run at a maximum of 500 meter intervals. Additional transverse profiles shall be run wherever necessary for clear delineation of existing pipeline.</p> <p>At every pipeline crossing, two additional longitudinal profiles at 350 m on either side of the proposed pipeline shall be run for a distance of at least 200 m on either side of the existing pipeline, so that the existing pipeline elevation with respect to seabed is clearly indicated.</p> <p>The Contractor shall simultaneously analyze the records on board. In case, obstructions are discovered on assigned routes, alternate routes should be selected in the field and survey profiles run/made for the alternate routes subject to Company's approval.</p> <p>Shallow Soil Sampling</p> <p>Piston gravity corer (modified kullenberg) having 6 m barrel fitted with an interval PVC liner and a cutting shoe at the bottom shall be deployed for collecting soil samples. In case of sands, a core catcher shall be provided in side the shoe to assist retention of the sample during retrieval of the sampler. Alternatively a vibro-corer can be employed for collecting soil samples in granular soils.</p>				
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<p>Based on interpretation of shallow seismic profiles determined by the Contractor, the spacing between sample locations shall be such that different types of strata encountered along the route are covered. However, the spacing between two consecutive sample locations shall not exceed 1 km. Additional soil samples shall be collected at all envisaged pipeline crossing and other such pipeline features.</p> <p>At location where sand with shale fragments/gravel is encountered and piston gravity corer refuses to penetrate the seafloor on repeated attempts, grab samples shall be collected if the Company Representative is satisfied that piston sample cannot be collected.</p> <p>All samples shall be extruded in the field and carefully examined and visually classified on board the vessel. Samples shall be tested in the on-board laboratory for classification purposes and for broad assessment of strength. Representative samples shall be properly sealed and carefully packed for transportation to onshore laboratory for additional examination and testing. Testing facilities on board the vessel shall include, but not limited to, the following :</p> <ol style="list-style-type: none"> Natural moisture content Dry and bulk density Torvane Motor vane Tricon (unconsolidated un-drained triaxial compression test). <p>Selected samples transported to onshore laboratory shall be tested to determine the following properties to supplement the information obtained in the field which together shall be used to determine soil parameters for pipeline design and installation :</p> <ol style="list-style-type: none"> Carbonate content Specific gravity Grain size distribution 				
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<p>iii. Atterberg limits</p> <p>iv. Indicative shear strength parameters of soils</p> <p>v. Coefficient of friction between pipeline and soils</p> <p>vi. Liquefaction potential</p> <p>vii. Electrical resistivity</p> <p>viii. Chlorides and sulphates</p> <p>All the shallow seismic survey results shall be correlated with soil data. Segment by segment profile and its geotechnical characteristics shall be developed. Contractor shall generate all the necessary soil parameters and submit for Company approval before use in analysis and design.</p> <p>Operation will be stopped at the discretion of the Contractor, when the sea state becomes too excessive (greater than BF-3) to obtain quality survey results.</p> <p>The Contractor shall supply vessels capable of working in the offshore Arabian Sea continuously 24 hours per day. The vessel shall have installed on it, all the equipment, before the beginning of the work, so that the survey will begin when the vessels arrives at site. The vessel shall have a data interpretation room with all auxiliary facilities to do the preliminary on board interpretation.</p> <p>4.1 Bathymetry</p> <p>The surveyor shall use a dual channel echo-sounder with heave compensator, filter etc. to obtain a complete representation of the sea bottom along each of the designated pipelines routes, and be able to define contours with a maximum relative accuracy of 0.05 meter. For the wide band surveys, bathymetric contours with 1 meter interval are acceptable. The water depth shall be referenced to Chart Datum (Indian Spring Low Water).</p> <p>4.2 Side Scan Sonar</p> <p>A survey of the sea-bottom by means of side-scan sonar shall be carried out to complete a morphology map of the zone investigated. Double coverage and beam angle shall be such that no blind zones exist in the designated survey areas. The</p>				
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<p>towed vehicle positioning system shall be such that the vehicle location relative to the ship is known at any moment.</p> <p>The maximum towing speed shall not exceed 5-6 kmph (3 knots). The records obtained by means of this equipment shall be suitable to form a complete morphological map of areas investigated.</p> <p>4.3 Sub Bottom Profile</p> <p>To establish the geometry, structure and configuration of the geological strata along the pipeline corridors, sub bottom profiling shall be performed with a system suitable to giving minimum penetration of 10 m or bedrock, whichever is shallower. The resolution shall be of the order of 15 cm at the surface. Vertical profiles of the shallow sediments shall be obtained. A pipeliner (pipeline profiler) shall be deployed for obtaining the above information.</p> <p>Considering the longer shallow water section and sandy bottom expected, interface equipment with profiler to improve data quality shall be implemented.</p> <p>Magnetometry</p> <p>The Contractor shall check for the presence of any metal objects on the sea floor, such as existing pipelines and communication cables, etc. and/or basic rock with a magnetometer. The location of these shall be given in the report.</p> <p>4.4 Riser Clamps</p> <p>4.4.1 Where risers are to be provided on existing platforms, Contractor shall carry out a survey of the jacket bracing members, where new clamps are to be located and of the existing clamps, where these are to be used, along with pre engineering route survey.</p> <p>4.4.2 Surveys will be carried out from the hanger flange to the lowest jacket member (by divers) and shall cover :</p> <ul style="list-style-type: none"> - An area of 1 m either side of proposed riser center line. - Identification of jacket, face, member, mudmat etc. 				
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<p>- Measurements</p> <p>- Inspection of the existing clamps and jacket bracing members, with reference to marine growth, anode location, corrosion, other obstruction, availability of clamps, bolts etc.</p> <p>- Video recordings with identification of platform location, elevation and proposed riser.</p> <p>- Two clear photographs of each existing clamp to be used and of the bracing member where proposed/planned clamps are to be installed.</p> <p>- If the proposed location of riser or use of existing clamps or proposed location of new clamps, found unsuitable for the intended purpose, the surveyor shall propose alternate location, survey the same and submit both the reports for Company's review.</p> <p>4.5 Video Recording Sector Scan Sonar</p> <p>To establish the configuration of risers and clamps, existing pipelines at platforms and at crossings, video recordings/sector-scan sonar survey shall be made. At each location the configuration and identification shall be presented in the recording.</p> <p>The coverage shall be to at least 100 meters either side of the existing line if visible and not buried. The coverage at platform complex shall be carried out on parallel lines at 50 meter intervals, keeping parallel to the face of the jacket for a distance of at least 500 meters.</p> <p>5.0 EQUIPMENT</p> <p>Contractor's equipment intended to be used for the surveying work shall be in excellent condition and properly calibrated to obtain accurate and quality data. The Contractor shall submit the details of equipment proposed to use in the survey to the Company for their approval.</p>				
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<p>6.0 SURVEYS RECORDS</p> <p>6.1 The Contractor shall conduct the survey and maintain proper records in order that all information required for route alignment selection, design & engineering, laying, trenching burial and back filling of pipelines can be obtained from these records.</p> <p>6.2 The Contractor shall submit minimum 3 sets of the preliminary survey report on board the vessel on completion of survey work. The preliminary report shall contain the following minimum information:</p> <ul style="list-style-type: none"> i. Brief description of survey procedures, including instrument calibration details. ii. Bathymetric data iii. Locations of soil samples iv. Brief description of samples v. Identification of any sub sea obstruction and/or seafloor instability. <p>6.3 The Contractor shall submit minimum six sets of the final analyzed survey report and photographs and three copies of all video recording/sector scan records along with three sets of video playback (including slow motion playback) for audio visual monitor (PAL VHS System) to the Company within six weeks from the completion of field survey. The final report shall contain the following information as a minimum :</p> <p>a. Pipelines</p> <ul style="list-style-type: none"> i. Description of survey methods, procedure, equipment and instrument calibration data. ii. Bathymetric chart and isopach of sediments, scale of 1:5000. iii. Identification of shallow subsea bed gas pockets, bed rock etc. iv. Identification of any subsea obstructions and/or seafloor instability. v. Soil data results. 				
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<div>vi. Identification of sub bottom sediment layer.</div> <div>vii. Presence of any metallic objects and/or debris on the sea floor</div> <div>viii. Tentative pipeline routes, scale of 1:5000. Approaches to platform complex scale of 1:500.</div> <div>ix. Condition of existing pipe, including position with respect to seabed, through on the route (356 OWF and 324 OWF).</div> <div>x. Longitudinal geological profile of the proposed pipeline routes.</div> <div>xi. Drawings indicating the orientations of connecting platforms and pipeline (with curvatures, co-ordinates etc).</div> <div>xii. Photographic copies of raw survey recordings identifying features of interest such as pipelines, crossings, anchors, metallic objects, subsea obstructions etc. and bathymetric and sub bottom discontinuities from the echo sounder, sub bottom profiler, side scan sonar and magnetometer.</div> <div>b. Riser Clamps</div> <div>i. Drawing showing elevation and plan of riser clamps and bracing members.</div> <div>ii. Details of all relevant measurement performed.</div> <div>iii. Details of bolts available, condition of hinge and neoprene liner.</div> <div>iv. Description of anomalies of damage/or obstructions in case of new clamps.</div> <div>v. Photographic copies as specified.</div> <div>6.4 All raw field data gathered on board shall be submitted to the Company on completion of the work.</div>				
<div>7.0 WORK REPORT</div>				
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<p>a. Geological and Geophysical Survey</p> <p>Run No.</p> <p>From</p> <p>To</p> <p>Whether along/across the proposed route or across the existing line</p> <p>Side Scan Record</p> <p>Width of Sea bed covered (Reqd. minimum = 150m)</p> <p>Distance between two parallel runs (required – 200 m)</p> <p>Echo Sounder Record</p> <p>Seabed Contour Resolution (Required = 0.5m)</p> <p>Remarks</p> <p>Sub Bottom Profile</p> <p>Penetration in the soil strata (Required minimum = 10 m or bed rock)</p> <p>Sub Bottom Profile</p> <p>Resolution (Required minimum = 15 cm at surface)</p> <p>Remarks</p> <p>(Signatures)</p> <p>Contractor's Representative</p> <p>Company's Representative</p> <p>b. Tidal Observation for Water Depth Correction</p>														
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Location Coordinates

Type of instrument required : Admiralty Tide Staff

Recording Interval : Required 15 minutes.

c. **Shallow Soil Sampling**

Eqpt. Used : Piston gravity Corer (Kullenberg)/Grab

Penetration : Required Minimum : Clay 3 m, sand 2m.

Sample Condition : Disturbed/undisturbed on board classification

Color photograph attached or not color with ref. Standard code

Note : Samples to be handled in horizontal position only.

8.0 **PROJECT SPECIFIC REQUIREMENTS**

Due to the variable nature of area/routes to be surveyed this project has special requirements. Surveyor shall ensure to implement all of these.

8.1 **Existing Pipeline Configuration**


Surveyor shall ensure that existing pipeline configuration falling within the survey corridor, shall be clearly delineated/charted.


If required, for the above requirement bidder shall run additional tracking runs to delineate the existing pipeline accurately.

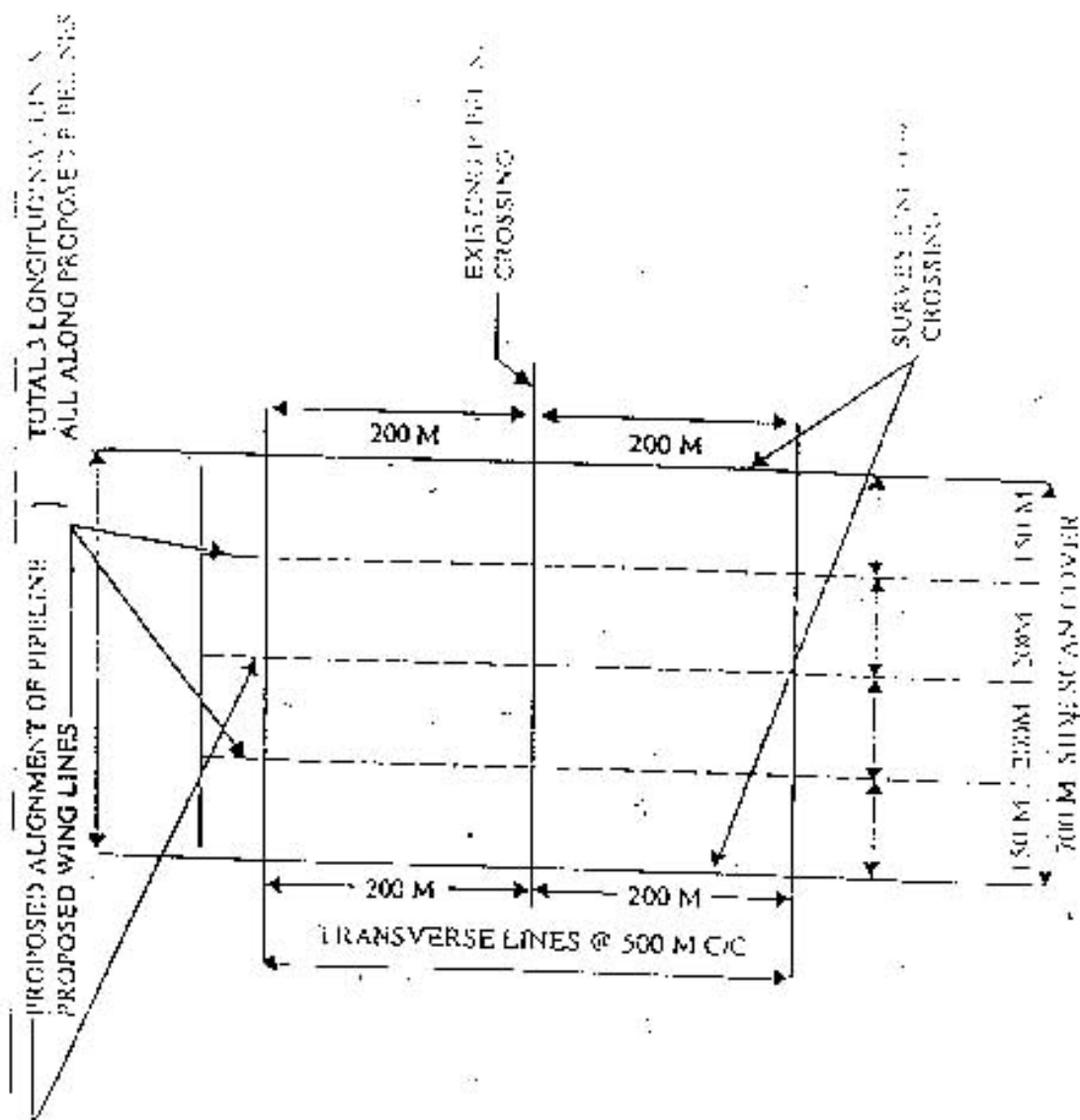
8.2 To establish the depth of burial and configuration of buried line, a pipeline tracker shall be used in the post construction as laid/as built survey. Surveyor shall develop a detailed deployment and survey plan for all congested areas and submit to Company for approval.

8.3 **Geodetic Control**


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<p>Surveyor shall ensure before commencement of each survey phase that coordinates of all reference/base stations envisaged to be used shall be of required accuracy and approved by Company.</p> <p>8.4 Minimum Technical Requirements & Characteristics</p> <p>The positioning system proposed shall comply with the following requirements as minimum.</p> <ul style="list-style-type: none"> - Shall have minimum three (3) base station set up if a radio-positioning system is used. - Shall have a prefixed reference station with radio/satcom link, if a DGPS system is used. - Shall have the capability of covering all the work area. - Shall have 24 hours per day operability - The on board receiver shall acquire at least three (3) LOP (lines of position) at all times. - The system accuracy, RMS (Root mean Square) shall be better than 1 meter in the complete work area. - A standard survey navigation software shall be used for survey navigation. <p>The station location shall be selected taking into consideration the following minimum requirements.</p> <ul style="list-style-type: none"> - Angle of intersection between LOP shall always be greater than 30 and less than 150 for a combination of three (3) ranges. - Sufficient back up stations to ensure correct positioning incase of the station system. - An uninterrupted coverage of work area. <p>8.5 On board data handling system</p>				
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<p>Minimum requirements of data handling system shall be as given below:</p> <p>An automatic data handling system along with plotter data logger shall be connected to the survey receivers to monitor and record the ship's position at all times. The ships position shall be fixed at intervals not exceeding 20 second whilst surveying.</p> <p>A hard copy of fix data shall be printed after each fix and shall as a minimum include :</p> <ul style="list-style-type: none"> - Fix number - Position (intum grid) - Raw Position data <p>Standard process-soft ware such as Delph-I shall be used for processing of shallow seismic data and the recording shall be done on standard SEG-Y format.</p> <p>8.6 Data Record on Floppy Disk</p> <p>All survey data shall be digitally recorded and information shall be supplied to the Company additionally on Floppy Disks.</p> <p>The acquisition methods used for geophysical data shall also be valid for isopaches of sediments.</p> <p>Different disks properly labeled shall be used for raw and analysed data.</p>				
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- NOTE: 1. Orig. not to scale
2. Additional survey lines at 50 m intervals parallel to the survey platform shall be run for a distance of 300 m along the proposed route alignment. Each line shall be 100 m long.

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1.0 SCOPE

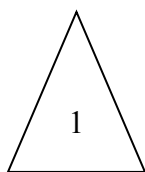
This specification covers the minimum requirements for supply/arrangement of all materials, plant, equipment, plant sites, consumables, utilities and application including all labour, supervision, inspection and tests etc. for application of external anti-corrosion coating of pipes for sub-sea pipelines by using 3 Layer Polypropylene coating conforming to DIN 30678.

The requirements specified are to apply externally the 3LPP coating system on the pipes to protect its corrosion. The coating system shall be suitable for over coating with concrete coating and installation using the S-lay method.

2.0 REFERENCE DOCUMENTS

The latest edition (edition enforce at the time of issue of enquiry) of the following standards, codes and specifications shall establish the minimum standards for the work.

Deutsches Institut für Normung (DIN)



DIN 30678 Polypropylene Coatings on Steel Pipes and Fittings – Requirements and Testing

DIN EN 10204 Metallic Products – Types of Inspection Documents

DIN 53735 Testing of Plastics – Determination of Melt Index of Thermoplastics.


Association Francaise de Normalisation (AFNOR)

NF A49-711 Steel Tubes: Three-Layer External coating based on Polypropylene – Application by Extrusion

API (American Petroleum Institute)

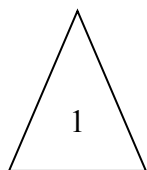
RP 5L9 External Fusion Bonded Epoxy Coating of Line Pipe

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International Organisation for Standardisation (ISO)


ISO 2808	Paints and Varnishes – Determination of film thickness
ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-2	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 2: Laboratory determination of chloride on cleaned surfaces
ISO 8502-3	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 11124	Preparation of Steel Substrates before Application of Paints and Related Products - Specifications for metallic blast-cleaning abrasives
ISO 21809-1	Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)



National Association of Corrosion Engineers (NACE)

NACE SP 0274	Standard Practice for High-Voltage Electrical Inspection of Pipeline Coatings.
NACE SP 0394	Standard Practice for Application, Performance and Quality Control of Plant Applied Single Layer Fusion-Bonded Epoxy External Pipeline Coating

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Others

CSA Z245.20-02 External Fusion Bonded Epoxy Coating for Steel Pipe.

Relevant ASTM standards

The CONTRACTOR shall be familiar with the requirements of these reference documents and shall make them available, as required, at the coating plant during the execution.

3.0 GENERAL REQUIREMENTS

3.1 The Contractor shall perform all work in accordance with this specification and other requirements noted.


Contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedure, materials, inspection, tests and repair etc. for Company approval.

3.2 The Contractor shall provide the skilled personnel required for execution of this work. The equipment required shall be in good operating condition. Improvised equipment shall not be acceptable.

3.3 The Contractor shall supply all coating materials required by this specification and shall carry out tests on one sample per batch of supply as described subsequently. The tests shall be carried out by the Contractor at his yard and the results shall be reported to the Company for approval and acceptance.

3.4 The Contractor shall unload the pipes at the coating plant; tally, store and provide security for the pipes during coating and storage. The Contractor shall be responsible for placement of the bare and coated pipes in storage in accordance with the reference specifications.

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3.5 All coating and wrapping operations shall be performed under the supervision of and performed by, personnel skilled in the application of the coating system. Inspection of the coating and wrapping of the pipes shall be performed by qualified inspectors. The qualification of the inspectors shall be verified and approved by the Company's Representative prior to the start of work. Final acceptance of all coating works shall be determined by the Company's Representative.

3.6 The Contractor shall provide access, during all phases of work, to the Company and Company's Representatives/inspectors. Any expense caused by the Company inspector stopping the work because it is not being carried out as per this specification shall be borne by Contractor.

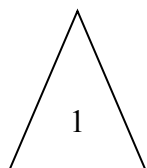
3.7 All tools and equipment furnished by the Contractor shall be of good quality, maintained in good operating condition and suitable for use to apply materials as per this specification. All equipment shall be subject to approval by the Company Representative.

All cleaning, priming and coating machines shall be equipped with rubber or wheels overlaid with hard fibre to prevent marking or denting the pipe.


3.8 The CONTRACTOR shall be responsible for obtaining all statutory approvals / clearances from relevant Authorities including Pollution Control Board, as applicable for the coating plant(s).

4.0 COATING MATERIALS

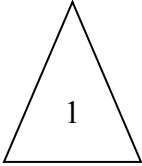
4.1 The three-layer coating system shall comprise of a powder epoxy primer, polymeric adhesive and a polypropylene top coat. Additionally, anti-slip rough coat with PP powder shall be applied. Coating materials shall be suitable for the service conditions and the pipe sizes involved. The coating materials i.e., epoxy powder, adhesive and polypropylene compound shall have proven compatibility. The coating system and materials shall be prequalified and approved by COMPANY in accordance with provisions of Annexure-I of this specification. CONTRACTOR shall obtain prior approval from COMPANY for the coating system and coating materials.



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4.2



The coating materials Manufacturer shall carry out tests for all properties specified in para 5.2 for each batch of epoxy, adhesive and polypropylene compound. In addition, the Manufacturer shall also furnish Infra-red scan for each batch of epoxy powder. The coating materials Manufacturer shall issue test certificates (in accordance with EN 10204, 3.1) as per the relevant standards/ methods specified in para 5.2, for each batch of materials supplied to Contractor and the same shall be submitted to Company for approval prior to their use.

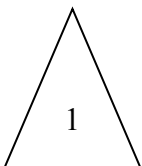
4.3

In addition to Manufacturer's certificate, the CONTRACTOR shall draw samples from each batch of epoxy, adhesive and polypropylene in the presence of COMPANY REPRESENTATIVE and test for the following properties at the coating yard at least one week prior to its use, to establish compliance with the Manufacturer's test certificates.

a) **FBE Powder**

- Gel time
- Sieve analysis
- Adhesion
- Density
- Moisture content
- Thermal analysis

b) **Adhesive**




- Melt flow index
- Vicat Softening Point
- Adhesion to FBE and polypropylene layers at 23°C, 90°C, 110°C and 120°C for applied 3LPP coating system
- Density

c) **Polypropylene Material**

- Density
- Melt flow index
- Moisture Content
- Oxidative Induction Time

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- Shore hardness
- Vicat softening point

The polypropylene shall be chemically modified for use at operating temperatures of up to 120°C on external surface of sub-sea pipeline section and shall contain additives as required to provide UV protection and shall be suitable for 3-layer polypropylene coating system.

4.4 In case of failure of any of the above tests in a batch, that batch of material shall be tested for all other tests required as per para 5.2.1 to 5.2.3 including the tests which failed. If all tests pass, the batch shall be accepted for coating. If any of the tests fail, entire batch of material shall be rejected and shall not be used for the coating.


4.5 All packages of powder shall be marked with the following data as a minimum.

- Manufacturer
- Material identification
- Batch number
- Place & Date of manufacture
- Shelf Life/ Expiration date (if applicable)
- Quantity
- Safety instructions
- Storage instructions (storage shall normally be at a temperature not greater than 25°C. All materials without above identification shall be rejected by Company. Such materials shall not be used for coating and shall be removed from site.)

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

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

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5.0 FUNCTIONAL REQUIREMENTS AND PROPERTIES OF COATING SYSTEM

5.1 The coating shall be able to withstand the maximum in service operating temperature of 120°C for sub-sea pipeline system.

5.2 Properties

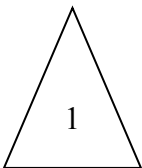
Properties of coating system and coating material shall comply the requirements indicated in subsequent paragraphs. In case, the coating/ material properties are tested as per test methods/ standards other than specified herein below, the same may be accepted provided the test procedures and test conditions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

5.2.1 Properties of FBE Powder


Contractor shall select epoxy powder that will achieve the functional requirements and properties of coating system as specified in para 5.1 and 5.2.4 of this specification respectively.

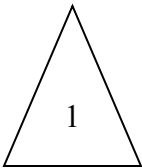
Typical Properties of FBE Powder shall be as follows:

Sl. No.	Properties	Requirement	Applied Standard
1	Specific Gravity	As defined by Manufacturer	ISO 2811-1
2	Moisture content	0.50% Max	API RP 5L9
3	Total Volatile content	0.60% Max	API RP 5L9
4	Particle size	0.1% Max Retained on 60 Mesh (250 Microns)	API RP 5L9
5	Cure Cycle	Capable of Cure at temperature below 260 °C	API RP 5L9
6	Glass Transition Temperature	Tg1 40-75 °C Tg2 >120 °C	NACE SP 0394



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Sl. No.	Properties	Requirement	Applied Standard
7	Wet Glass Transition Temperature	$T_g \geq 120^\circ\text{C}$	Manufacturer's Test Procedure
8	Heat of Reaction	As defined by Manufacturer	NACE SP 0394
9	Gel Time	As defined by Manufacturer	NACE SP 0394
10	Hardness Shore D	80-90	ASTM D 2240
11	Flexibility	Flexibility $> (3^\circ/\text{PD})$ at 0°C , PD = Pipe Dia.	API RP 5L9
12	Impact Resistance	2.0 Joule	API RP 5L9
13	Abrasion Resistance	300 mg Max (note-1)	API RP 5L9
14	Cathodic Disbondment	$\leq 5\text{ mm}$ at $23^\circ\text{C}/28\text{ days}$ $\leq 6\text{ mm}$ at $65^\circ\text{C} / 48\text{ hours}$ $\leq 7\text{ mm}$ at $95^\circ\text{C} / 48\text{ hour}$	NF A49-711
15	Dielectric Strength	Strength $> 500\text{ Volt / mil}$ (1 mil = 25 microns)	ASTM D 149
16	Hot Water Soak Test	50% max. of coating can be removed as per Rating 2 of standard	API RP 5L9

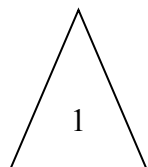
Note-1: Abrasive resistance is equal 300 mg max. by C.S 17 abrasive wheel /1000 gram / 1000

5.2.2 Properties of Adhesive

Contractor shall select adhesive that will achieve the functional requirements and properties of coating system as specified in para 5.1 and 5.2.4 of this specification respectively:

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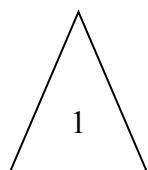


Sl. No.	Physical Properties	Requirement	Applied Standard
1.	Specific Gravity	0.89 – 0.92	ASTM D 1505 / ISO 1183
2.	Melt flow rate (MFR) 230°C/ 2.16 kg	According to Manufacturer's Specification	ISO 1133 / ASTM D1238
3.	Water Content	≤ 0.1%	ISO 15512
	Mechanical		
4.	Tensile Yield Strength	≥ 20 MPa	ASTM D 638 / ISO 527
5.	Tensile Elongation	≥ 350 %	ASTM D 638 / ISO 527
6.	Hardness Shore D	≥ 57	ASTM D 2240 / ISO 868
7.	Brittle Point	≤ -20°C	ASTM D 746
	Impact		
8.	Charpy V-Notch Impact Strength -20°C	≥ 3KJ/m ² (as per ISO 21809-1)	ISO 179-1/ 179-2
	Thermal		
9.	Vicat softening temperature	≥ 130°C	ASTM D 1525 / ISO 306

5.2.3 Properties of Polypropylene Compound


The polypropylene compound shall be UV and thermal stabilized co-polymer, designed for extrusion and suitable for continuous service at operating temperatures of up to 120°C for sub-sea/ onshore buried pipeline application.

Typical Properties of Polypropylene coating (Top Coat) shall be as follows:



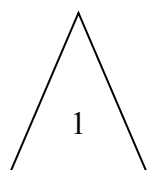
Sl. No.	Physical Properties	Requirement	Applied Standard
1.	Specific Gravity	≥ 0.89	ASTM D 1505 / ISO 1183
2.	Water Absorption	Max. 0.02% wgt	ASTM 570
3.	Water Content	≤ 0.05 %	ISO 15512
	Mechanical		

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Sl. No.	Physical Properties	Requirement	Applied Standard
4.	Tensile Yield Strength	≥ 20 MPa	ASTM D 638 / ISO 527-2 & -3
5.	Tensile Elongation	≥ 400 %	ASTM D 638 / ISO 527-2 & -3
6.	Hardness Shore D	≥ 60	ASTM D 2240 / ISO 868
	Impact		
7.	Charpy V-Notch Impact Strength -20°C	≥ 3 KJ/m ²	ISO 179-1/ 179-2
	Thermal		
8.	Vicat Softening temperature	≥ 130 °C	ASTM D 1525 / ISO 306

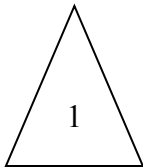
5.2.4 Properties of Coating System



Sl. No.	Properties	Requirement	Applied Standard
1	Appearance and continuity	Uniform colour, free of defects and discontinuities, delamination, separations and pinholes	NF A49-711
2	Impact Strength at 23±2°C	No failure after 30 impacts, when tested with 25KV Impact Energy: ≥ 10 J/mm	DIN 30678
3	Indentation Resistance	Max. 0.1 mm at 23°C; Max. 0.4 mm at 110°C;	DIN 30678
4	Elongation at break of the PP at 23 ± 2 °C	Min. 400 %	ASTM D 638 / ISO 527-2 & ISO 527-3
5	UV Resistance & Thermal Ageing (Change in Elongation)	260%	NF A49-711
6	Bond Strength	Min. 250 N/cm at 23°C; 80 N/cm at 90°C; 40 N/cm at 110°C; 30 N/cm at 120°C (at peel off rate 10mm/min)	DIN 30678 / NF A49-711
7	Hot water soak test for FBE	No loss of adhesion / Rating 1	API RP 5L9

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Sl. No.	Properties	Requirement	Applied Standard
8	Degree of Cure of the epoxy (1st Layer)	ΔT_g : - 2°C to +3°C; Cure: Min 95%	NACE SP 0394
9	Porosity of FBE (Cross- sectional & Interface)	Rating 1	NACE SP 0394
10	Interface Contamination of FBE	Maximum 30%	NACE SP 0394
11	Shore D Hardness	≥ 60	ASTM D2240 / ISO 868
12	Product stability during extrusion process of the PP top layer	Δ MFR: $\leq 35\%$ (Variation between virgin compounded granulate before extrusion / extruded film after extrusion of the same batch)	ISO 1133
13	Average Cathodic Disbonding Length	≤ 5 mm at 23°C/28 days ≤ 6 mm at 65°C / 48 hours ≤ 7 mm at 95°C/48 hours	NF A49-711

6.0 MEASUREMENT AND LOGGING

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

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7.0 COATING PROCEDURE AND QUALIFICATION

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


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

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

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

- Pipe inspection at the time of bare pipe receipt.
- Steel surface preparation, including preheating, removal of steel defects, method of pipe cleaning, dust removal, abrasive blast cleaning and surface profile; methods of measurements and consumables.


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- c. Pipe heating, temperatures and control prior to epoxy application.
- d. Complete details of raw materials including current data sheets showing values for all the properties specified together with quality control and application procedure recommendations from manufacturer(s).
- e. Application of FBE powder, adhesive, polypropylene and rough coat (if any), including characteristics, temperature, line speed, application window, curing time, etc.
- f. Quenching and cooling, including time and temperature.
- g. Quality Assurance System, Inspection and Test Plan and reporting formats, including instrument and equipment types, makes and uses, etc.
- h. Detailed method of repair of coating defects duly classified depending upon nature and magnitude of defects and repair thereof including coating stripping technique
- i. Details of instrument and equipment calibration methods including relevant standards and examples of calibration certificates.
- j. Complete details and inventory of laboratory and equipment for procedure qualification and regular production
- k. Pipe handling and stock piling procedures
- l. Sample of recording and reporting formats, including laboratory reports, certificates and requirement as per clause 6.0 of this specification.
- m. Complete details of test certificates for raw materials including test methods and standards used.
- n. Test certificates from PP compound manufacturer for tests for thermal aging, coating resistivity and aging under exposure to light. These test certificates shall not be older than three years.
- o. Health, Safety and Environment Plans.
- p. Storage details of coating materials and chemicals.
- q. Continuous temperature monitoring at various stages of coating

Procedure Qualification Tests (PQT) shall be carried out only after obtaining written approval of the above procedure from COMPANY. No change in the procedure shall be made after the COMPANY has given approval. However, unavoidable changes shall be executed only after obtaining written approval from COMPANY.

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7.3 Prior to start of production, the CONTRACTOR shall, at his expense, carry out a coating PQT for each pipe diameter on max. wall thickness, for each type of pipe, for each coating material combination, and for each plant, to prove that his plant, materials, and coating procedures result in a quality of end product conforming to the properties stated in clause 5.2, relevant standards, specifications and material manufacturer's recommendations.

CONTRACTOR shall give seven (7) working days' notice to witness all procedures and tests.


A batch representing a normal production run, typically 15 pipes, shall be coated in accordance with the approved coating procedure and the coating operations witnessed by COMPANY Representative. Out of these pipes, at least one pipe shall be coated partly with epoxy and partly with both epoxy and adhesive layers.

At least 5 (five) test pipes shall be selected by COMPANY Representative for coating procedure approval tests and shall be subjected to procedure qualification testing as described hereinafter. COMPANY Representative shall witness all tests. Out of 5 (five) test pipes, 1 (one) pipe partly coated with epoxy and partly coated with both epoxy and adhesive layers shall be included. Remaining 4 (four) test pipes shall have all three layers.

During PQT, the CONTRACTOR shall qualify various procedures forming a part of coating operations as detailed subsequently. Pipe partly coated with epoxy and partly coated with both epoxy and adhesive layers and the pipes coated with all three layers shall be subjected to complete set of tests as detailed in para 7.5 and specified in Appendix-1.

Pipes selected for PQT shall pass all the criteria contained in Appendix-1 before production commences.

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7.4 Qualification of Procedures

7.4.1 Epoxy Powder Application & Recycling

During pre-qualification, air pressure in the epoxy spray guns, satisfactory functioning of monitoring system, line speed vs coating thickness, etc. shall be established. Dew point of air used to supply the fluidized bed, and epoxy spray system shall be recorded during the PQT. No epoxy recycling is permitted.

7.4.2 Pipe Pre-heating

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


7.4.3 Surface Preparation

The procedure to clean and prepare the pipe surface shall be in accordance with the requirements of para 8.0 of this specification. The ratio of shot to grit shall be established during procedure qualification testing, such that the resultant surface profile is not dished and rounded. The qualification shall be performed through a visual inspection, measurement of roughness and check of the presence of dust on the abrasive blast cleaned pipe surface.

7.4.4 Coating Application

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

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7.5 Qualification of Applied Coating:

7.5.1 Tests on pipe coated partly with epoxy and partly with epoxy & adhesive layers

a. Degree of Cure

Epoxy film samples (minimum 4 no.) shall be scrapped from the coated pipe and the samples shall be taken for cure test using Differential Scanning Calorimetry (DSC) procedure. Care shall be taken to remove the samples of full film thickness avoiding inclusion of steel debris. Glass transition temperature differential (ΔT_g) and % Cure shall comply with the specified requirements.

b. Epoxy Layer Thickness

Epoxy layer thickness shall be checked at every one meter spacing at 3, 6, 9 and 12 o'clock positions. The thickness shall comply with the specified thickness requirements.

c. Adhesive layer Thickness

Adhesive layer thickness shall be checked at every one meter spacing at 3, 6, 9 and 12 o'clock positions. The thickness shall comply with the specified thickness requirements.


d. Holiday Inspection

Entire pipe shall be subject to holiday inspection and the test voltage shall be set @ 5 v/micron (minimum) of epoxy thickness specified for the portion coated only with epoxy layer.

e. Adhesion Test

- Adhesion Test (24 hrs. at 95°C) shall be carried out on the epoxy coated pipe. Test method, no. of test specimen and acceptance criteria shall comply API RP 5L9.
- Adhesion of FBE shall also be separately determined at ambient temperature at two locations by the "St Andrews Cross" method and the test shall comply with the specified requirement as stated in APPENDIX-1.

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f. 2.5° Flexibility Test

2.5° Flexibility test shall be carried out on the epoxy coated pipe at test temperature of 0°C. Test method, no. of test specimen and acceptance criteria shall comply API RP 5L9.

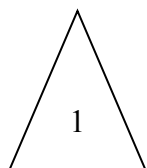
g. Cross-section & Interface Porosity Test

Cross section porosity and interface porosity tests shall be carried out on the epoxy coated pipe. Test method, no. of test specimen and acceptance criteria shall comply NACE SP 0394.

h. Interface Contamination Test

Interface contamination test shall be carried out on the epoxy coated pipe. Test method, no. of test specimen and acceptance criteria shall comply NACE SP 0394.

7.5.2 Tests on pipes coated with all three layers



a. Bond Strength:

Three test pipes shall be selected for bond strength tests. On each of the selected pipes, three bond strength test shall be performed for each specified temperature i.e. one at each end and one in the middle of the pipe and specified requirements shall be complied with, i.e. bond strength as well as mode of separation. Length of peel shall be minimum 100 mm. None of these samples shall fail.

b. Impact Strength:

Three test pipes shall be selected for impact strength test and the test shall meet the specified requirements.


c. Indentation Hardness:

Two samples for both temperatures from all pipes shall be taken. If any one of these samples fail to satisfy the specified requirements, then the test shall be repeated on four more samples. In this case, none of the samples shall fail.

d. Elongation at failure:

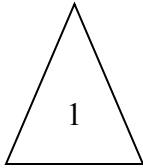
Six samples each from three coated pipes i.e. 18 samples in all shall be tested and

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the test shall comply the specified requirement. Only one sample per pipe may fail.

e. Cathodic Disbondment Test:



Three CD tests shall be carried out for the total lot of test pipes having all three layers. One test shall be carried out for 28 days duration at 23°C and two tests for 48 hours duration at 65°C & 95°C respectively. The tests shall comply the specified requirement. Whenever Procedure Qualification is necessitated for different pipe size with same coating material combination, 48 hours test only be conducted. 28 days CD test is not mandatory in this case.

f. Holiday Inspection

All the pipes shall be subject to holiday inspection. The test voltage shall be as specified in para 10.5.2.

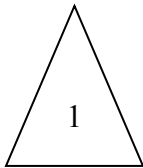
g. Coating Thickness Measurement

All pipes shall be subject to coating thickness measurements. Acceptance criteria shall be as per para 10.4.3.

h. Air Entrapment


One sample each from pipe body and on weld (if applicable) shall be taken from all four coated pipes and the specified requirements shall be complied with.

i. Degree of Cure



Epoxy film samples (minimum 4 no., equally spaced) shall be scrapped from one coated pipe and the samples shall be taken for cure test using Differential Scanning Calorimetry (DSC) procedure. Applied FBE layer (randomly selected pipe at any time) shall be removed carefully to check that it is completely free of adhesive, steel particle and other contamination. Care shall be taken to remove the samples of full film thickness avoiding inclusion of steel debris. Glass transition temperature differential (ΔT_g) and % Cure shall comply with the specified requirements.

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7.5.3 Inspection of all test pipes

All pipes shall be subject to the following inspections:

- a. Surface cleanliness, surface roughness measurements and dust control immediately after second abrasive blast cleaning and salt test.
- b. Visual inspection of finished coating, cut back dimension, internal / external cleanliness, end sealing and bevel inspection.

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


7.6 After completion of the qualification tests and inspection as per para 7.4 and 7.5 above, the CONTRACTOR shall prepare and issue to COMPANY for approval a detailed report of the above tests and inspection including test reports/certificates of all materials and coatings tested. Only upon written approval from COMPANY, CONTRACTOR shall commence production coating.

7.7 On successful completion of PQT, coating of all five (5) test pipes shall be removed and completely recycled as per the approved coating procedure specification, at CONTRACTOR's expense. Remaining pipes will be accepted by COMPANY provided they meet the requirements of this specification and need not be stripped and re-cycled.

7.8 The CONTRACTOR shall re-establish the requirements of qualification and in a manner as stated before or to the extent considered necessary by COMPANY, in the event of, but not limited to, the following:

- Every time there is a change in the previously qualified procedure.
- Every time there is a change in the manufacturer and change in formulation of any of the raw materials and change in location of raw material manufacture.
- Every time the coating yard is shifted from one location to the other or every time the critical coating equipment (induction heater, epoxy spray system, extruder, etc.) are shifted.
- Any change in line speed during coating application

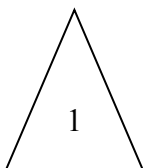
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- Any time when in COMPANY's opinion the properties are deemed to be suspect during regular production tests.

7.9 COMPANY reserves the right to conduct any or all the test required for qualification through an independent laboratory or agency at the cost of CONTRACTOR when in COMPANY's opinion, the results are deemed suspect. COMPANY's decision shall be final.

7.10 Applicator shall performed qualification of repair procedure in reference with material manufacturer's recommendations. Qualification of Repair Procedure shall be a part of PQT. Minimum 2 nos. of each type of coating repair shall be demonstrated in presence of company representative to qualify Coating Repair Procedure prior to its use. Details of Inspection and Testing shall be in accordance with Clause 12.0 of this functional specification.




8.0 PIPE SURFACE PREPARATION

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

8.2 Prior to cleaning operation, CONTRACTOR shall visually examine the pipes and shall ensure that all defects, flats and other damages have been repaired or removed. The CONTRACTOR shall also remove marking stickers, if any, present within the pipe. Record shall be kept of such marking on the stickers to ensure traceability of pipe after coating.

8.3 Any oil, grease, salt or other contaminants detrimental to the formation of a good coating bond or coating quality shall be removed prior to coating application. Contaminants may be removed by the use of non-oily solvents. Gasoline or kerosene shall not be used for this purpose. Visible oil and grease spots shall be removed by solvent wiping. Solvent cleaning shall be in accordance with SSPC-SP1. Steel surface shall be allowed to dry before abrasive cleaning.

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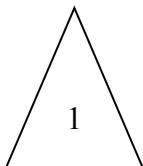
- 8.4** All pipes shall be preheated to a temperature of 65°C to 85°C prior to abrasive blast cleaning. The external surface of the pipe shall be cleaned using 2 nos. of dry abrasive blast cleaning units to achieve the specified surface cleanliness and profile. After first abrasive blast cleaning, chemical pre-treatment with phosphoric acid solution as per para 8.6 shall be carried out prior to second abrasive blast cleaning. However, at the option of CONTRACTOR, chemical pre-treatment with phosphoric acid solution as per para 8.6 may be carried out after the second abrasive blaster.

The abrasive blast cleaning units shall have an effective dust collection system to ensure total removal of dust generated during blast cleaning from the pipe surface. The equipment used for abrasive blast cleaning shall meet the specified requirements and shall be free from oil, water soluble salts and other forms of contamination to ensure that the cleaning process is not impaired. Traps, separators and filters shall be checked for condensed water and oil at the start of each shift and emptied and cleaned regularly. During abrasive blast cleaning, the metallic abrasive shall be continuously sieved to remove “fines” and “contaminants” and the quality checked at every four hours. Abrasives used for blast cleaning shall comply ISO-11124.

- 8.5** Suitable plugs shall be provided at both pipe ends to prevent entry of any shot/grit into the pipe during blast cleaning operations. These plugs shall be removed after blast cleaning. Alternatively, the CONTRACTOR may link the pipes suitably together to prevent the entry of any short/grit into the pipe.


8.6 Chemical Pre-treatment with Phosphoric Acid Solution:

- 8.6.1** All pipes shall be provided chemical pre-treatment with phosphoric acid solution. 10-12% solution of phosphoric acid, Oakite 31 / 33 or equivalent, shall be used to remove all soluble salts and other soluble contaminants.



The CONTRACTOR shall provide data sheets and supporting documentation for the phosphoric acid to be used. The documentation shall verify that the phosphoric acid is suitable for the treatment of line pipe prior to the application of the specific fusion bonded epoxy powder being applied and the final coating will meet fully the

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requirements of this specification.

- 8.6.2** The pipe temperature immediately prior to the phosphoric acid treatment shall be in the range of 45 to 75 °C. Phosphoric acid treatment shall be followed immediately by washing with de-ionized water. De-ionized water used shall conform to the following requirements:


Sl. No.	Properties	Unit	Requirement
1.	Turbidity	NTU	1 max.
2.	Conductivity	μmho/cm	5 max.
3.	Hardness	-	NIL
4.	Total Alkalinity as CaCO ₃	mg/l	2 to 3
5.	Chloride as Cl ⁻	mg/l	1 max.
6.	Sulphate as SO ₄	mg/l	1 max.
7.	pH	-	6.5 to 7.5

Tests to determine the above properties shall be carried out in accordance with “Standard Methods for the Examination of Water and Wastewater” published jointly by American Public Health Association, American Water Works Association and Water Pollution Control Federation.

Quality of the de-ionized water shall be monitored at the start of each shift and at every four hours interval. Non-compliance of de-ionized water w.r.t. the above requirements shall cause for stoppage of the operations.

- 8.6.3** The pH of the pipe surface shall be determined both before and after the de-ionized water rinse initially on each pipe and in case of consistent results, the frequency may be relaxed to once per hour at the discretion of COMPANY Representative. The measured pH shall be as follows:

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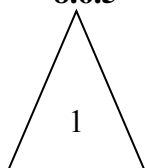
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Before de-ionized water wash: 1 to 2

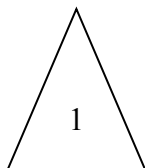
After de-ionized water wash: 6 to 7

8.6.4 After the de-ionized water wash, the pipe shall be dried with dry air and preheated to a temperature of 65°C to 85°C.

8.6.5 The salt tests shall be carried out after de-ionized water rinse. One test shall be carried out at both ends of each pipe. The acceptance criteria shall be Max. 2 µg/cm². An approved salt meter (SCM 400 or equivalent) shall be used to carry out salt tests and shall be calibrated in accordance with the equipment manufacturer's recommendations.




8.7 Abrasive cleaning carried out shall be such that the resultant surface profile is not dished and rounded when viewed with 30X magnification. The standard of finish for cleaned pipe shall conform to near white metal finish to Sa 2½ of Swedish Standard SIS 055900 latest edition. Surface of pipe after abrasive blast cleaning shall have an anchor pattern of 50 to 80 microns (RZ). This shall be measured for each pipe by a suitable instrument such as surface profile depth gauge. In addition, the pipe surface after blast cleaning shall be checked for the degree of cleanliness (Sa 2½), degree of dust and shape of profile. Degree of dust shall comply the requirements of ISO 8502-3. Acceptance limit shall be either quality rating 2 or Class 2.



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

8.9 At no time shall the blast cleaning be performed when the relative humidity exceeds 85%. The CONTRACTOR shall measure the ambient conditions at regular intervals

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during blast cleaning and coating operations and keep records of prevailing temperature, humidity and dew point.

- 8.10** The blast cleaned surface shall not be contaminated with dirt, dust, metal particles, oil, water or any other foreign material, nor shall the surface or its anchor pattern be scarred or burnished. All blast cleaned pipe surface shall be kept in dust free enclosure prior to coating. After blast cleaning, all surfaces shall be thoroughly inspected under adequate lighting to determine anchor pattern, quality of blasting and identify any surface defects prior to coating application. All surface defects such as slivers, scab, burns, laminations, welds spatters, gouges, scores, indentations, slugs or any other defects considered injurious to the coating integrity made visible during blast cleaning shall be reported to the COMPANY Representative and on permission from COMPANY Representative, such defects shall be removed by filing or grinding. After any grinding or mechanical repairs, the remaining wall thickness shall be checked and compared with specified thickness. Any pipes having thickness less than 95% of specified thickness shall be kept aside and disposed of as per the instructions of COMPANY Representative. The method employed to remove surface defects shall not burnish or destroy the anchor pattern or contaminate the surface. Pneumatic tools shall not be used unless they are fitted with effective air/oil and water traps. Where burnishing results in destruction of anchor pattern, the anchor pattern shall be restored by suitable means. Pipes which have damages repaired by grinding and have ground areas more than 50 mm in diameter shall be re-blasted. Any dust or loose residues that have been accumulated during blasting and/or during filing/grinding operations shall be removed by vacuum cleaning.

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

- 8.11** Upon Completion of the blasting operations, the quality control supervisor shall accept the pipe for further processing or return for re-blasting after removal of defects/imperfections. In case imperfections are considered detrimental to the coating quality, the same shall be reported to COMPANY's Representative for final decision on rejection or re-blasting / removal of defects. Re-blasting / removal of defects or returning

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pipe to the yard shall be at the CONTRACTOR's cost.

COMPANY's Representative, in additions, reserves the right to initiate any of the above actions during periodic inspections for oil, dust, salt, imperfections, surface defects, lack of white metal finish, etc.

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

8.13 Chemical Pre-treatment with Chromate Solution

8.13.1 Following completion of abrasive blast cleaning, all pipe surface shall be chemically pre-treated with a 10 – 12 % strength chromate solution.


8.13.2 The CONTRACTOR shall provide data sheets and supporting documentation for the chemical to be used. The documentation shall verify that the chemical is suitable for the treatment of line pipe prior to the application of the specific fusion bonded epoxy powder being applied and the final coating will meet fully the requirements of this specification.

8.13.3 The chemical pre-treatment shall be applied fully in accordance with the chemical suppliers' instructions and in a manner that ensures 100% uniform coverage of the pipe surface without introducing surface contamination.

8.13.4 The CONTRACTOR shall check that the concentration of the chemical pre-treatment solution remains within the range recommended by the chemical manufacturer for the pipe coating process. The concentration shall be checked at the make-up of each fresh solution and once per hour, using a method approved by the chemical manufacturer. The CONTRACTOR shall also ensure that the chemical pre-treatment solution remains free from contamination at all times. Recycling of chemical pre-treatment solution is not permitted.

8.13.5 The CONTRACTOR shall ensure that the temperature of the substrate is maintained between 40°C and 80°C and the chromate solution temperature does not exceed 60° or as recommended by the manufacturer.

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8.13.6 The chromate coating shall be smooth, even, free from runs, drips or excessive application and lightly adherent with no flaking of the coating. The chromate coated steel must be thoroughly dried immediately after application and shall be achieved by boiling off any residual solution on the surface.

8.14 The total allowable elapsed time between completion of the blasting operations and commencement of the pre-coating and heating operations shall be such that no detectable oxidation of the surface occurs. Relative humidity readings shall be recorded every half an hour during the blasting operations in the immediate vicinity of the operations. The maximum elapsed time shall not exceed the duration given below:

Relative Humidity %	Maximum elapsed time
> 80	2 hours
70 to 80	3 hours
< 70	4 hours


Any pipe not processed within the above time-humidity requirement shall be completely re-blasted. Any pipe showing flash rusting shall be re-blasted even if the above conditions have not been exceeded.

8.15 Pipe handling between abrasive blasting and pipe coating shall not damage the surface profile achieved during blasting. Any pipe affected by the damage to the surface exceeding 200 mm² in area and/or having contamination of steel surface shall be rejected and sent for re-blasting.

9.0 COATING APPLICATION

The external surface of the cleaned pipe conforming to clause 8.0 of this specification shall be immediately coated with 3-layer polypropylene coating in accordance with the procedures approved by COMPANY, relevant standards and this specification. In general the procedure shall be as follows:


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9.1 Pipe Heating

- 9.1.1** Immediately prior to heating of pipe, all dust and grit shall be removed from inside of the pipe by a combination of air blast, brushing and vacuum cleaning. Suitable arrangement shall be made to protect the bevel ends from getting damaged during the coating operation.
- 9.1.2** Induction heater or gas fired heating shall be used for heating the pipe. The method shall be capable of maintaining uniform temperature along the total length of the pipe, and shall be such that it shall not contaminate the surface to be coated. In case of induction heating, appropriate frequency shall be used to ensure 'deep heating' and intense skin heating is avoided. Gas fired heating system shall be well adjusted so that no combustion products are deposited on the steel surface. This shall be demonstrated on bare pipes prior to start of PQT. Oxidation of the cleaned pipe surfaces prior to coating (in the form of blueing or other apparent oxide formation) is not acceptable.
- 9.1.3** The pipe shall be uniformly preheated to a temperature of 220°C to 235°C (425 to 450°F) or as per MANUFACTURER's recommendation. The pipe metal temperature shall not exceed 275°C (575°F).
- 9.1.4** Temperature of the pipe surface shall be continuously monitored & recorded by using suitable instruments such as infrared sensors, contact thermometers, thermocouples etc. The recording method shall allow to correlate each line pipe. The monitoring instrument shall be able to raise an alarm / activate audio system (hooter) in the event of tripping of induction heater / gas fired heater or in the event of pipe temperature being outside the range recommended by the manufacturer. Any deviation from the application temperature range recommended by manufacturer shall be rectified. If immediate rectification is not feasible, the production shall be stopped until cause of deviation has been removed. Any pipe coated during the duration of temperature deviation shall be identified by marking and rejected. Such rejected pipes shall be stripped, re-cleaned and recoated.

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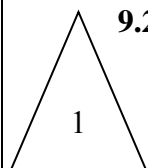
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9.1.5 Temperature measuring & monitoring equipment shall be calibrated twice every shift and/or as per COMPANY Representative's instruction.

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

9.2 FBE Layer Coating

9.2.1 Thickness of FBE layer shall be between 350 and 500 microns.



9.2.2 Oxidation of the steel prior to coating in the form of 'blueing' or other apparent oxide formation is not acceptable. If such oxidation occurs, the pipe shall be set aside and re-cleaned.

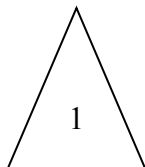
9.2.3 Prior to starting the fusion bonded epoxy powder application, the recovery systems shall be thoroughly cleaned to remove any unused powder.

9.2.4 The use of recycled powder shall not be permitted.

9.2.5 Epoxy powder is sprayed using electrostatic spray guns. Pipe must be well grounded during the entire process of coating application. Proper charge on the powder must be maintained. Guns should be positioned to make optimum use of electrostatic properties and to minimize overspray.


9.3 Adhesive Layer Coating

9.3.1 Thickness of adhesive shall be between 250 and 400 microns.



The CONTRACTOR shall ensure that the rollers push adhesive film to eliminate any air entrapment or voids. The adhesive layer shall be applied before gel time of the FBE has expired by using either the cross-head or lateral extrusion technique. Application of the adhesive shall not be permitted after the FBE has fully cured. The CONTRACTOR shall establish to the satisfaction of COMPANY's representative that the adhesive is applied within the gel time window of the FBE and at the temperature recommended by the

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adhesive MANUFACTURER. The CONTRACTOR shall state the proposed minimum and maximum time interval between FBE and adhesive applications at the pipe temperature range and overlap.

9.4 Polypropylene Layer Coating

9.4.1 The number of wrap and overlapping shall be such that they polypropylene thickness achieved meets the overall specified thickness requirement.

9.4.2 Polypropylene may be applied by either the cross-head or lateral extrusion technique. The polypropylene shall be applied over the adhesive within the time limits established during pre-production testing.

9.4.3 As the concrete weight coating will be applied on the three layer polypropylene system, the coating surface shall be worked in a way to improve friction coefficient and enhance the bonding of concrete to the extruded polypropylene surface. Granules of polypropylene shall be spray applied to the hot extruded polypropylene surface before quenching. Such granules shall not be totally melted to provide a rough surface.


9.4.4 The coating shall be cooled to below 80°C before handling.

9.4.5 Coating and/or adhesive shall terminate 120 mm (+) 20 / (-) 0 mm from pipe ends. The adhesive shall seal the end of applied coating. CONTRACTOR shall adopt mechanical brushing for termination of the coating at pipe ends. Edge of the coating shall be shaped to form a bevel angle of 30° to 45°. The cut back length shall be 150 (+) 20 / (-) 0 mm width, bevel 30° to 45° if specified by purchaser (in case of Automatic UT and Automatic Welding).

9.4.6 Immediately after the coating is fully cured, pipe identification marks shall be reapplied to the coated pipe using a method approved by the COMPANY's representative. Additional identification shall be made in order to monitor the coating and test batches. All such markings shall be within 2 meters of the pipe end.

9.4.7 Failure to comply with any of the above applicable requirement and of the approved

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procedure shall be cause for the rejection of the coating and such coating shall be removed in a manner approved by COMPANY at CONTRACTOR's expense.

10.0 INSPECTION AND TESTING

10.1 General

In addition to the tests required on the material batches, the CONTRACTOR shall perform the tests detailed below on finished production coatings to demonstrate compliance with this specification. Details of all inspections and testing shall be fully documented in accordance with Section 15.

10.2 Production Testing

10.2.1 Production testing shall be performed at the frequency shown in Appendix 2.

10.2.2 The frequency of tests shown in Appendix 2 will be for normal production operations. This frequency of tests will also be required after a change in normal operations as a result of material change or quality acceptance.


10.3 Visual Inspection

The following external surfaces of the coated pipe shall be carefully inspected:

- Adjacent to the cut-back at each end of pipe.
- Adjacent to the longitudinal weld
- Within the body of the pipe.

The coating shall be of natural colour, smooth & uniform and shall be blemish free with no dust or other particulate inclusions. The coating shall not show any defects such as blisters, pinholes, wrinkles, scratches, engravings, cuts, swellings, excess material thickness, dis-bonded zones, air inclusions, tears, voids, etc. In addition, inside surface of the pipe shall also be visually inspected for presence of any foreign material or shots and grit (free or embedded/sticking to pipe inside surface). The pipe inside surface shall be examined using sharp floodlight focused at the middle of the pipe at one end while inspection is carried out visually from another end.

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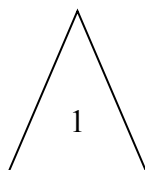
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10.4 Coating Thickness

10.4.1 The thickness of the cooled polypropylene coating system shall be checked using an approved magnetic or electro-magnetic thickness gauge.

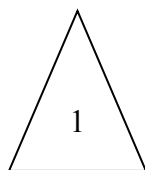
10.4.2 Measurements shall be made at 12 points uniformly spaced over the length and circumference of pipe. In case of welded pipes, five of the above readings shall be made at the apex of the weld seam, uniformly distributed over the length of the coated pipe.

10.4.3 The minimum coating thickness on pipe surface shall be as per the table below. However, localized coating thickness of less than the permissible minimum thickness can be tolerated on the condition that it does not attain a total extent of more than 5 cm² per meter length of coated pipe, and the actual coating thickness does not drop more than 10% below the permissible minimum coating thickness at these locations.



Pipe OD (Inch)	Coating Thickness (mm)
≤ 6.625	2.5
> 6.625 and ≤ 12.75	3.0
> 12.75	3.5


10.4.4 The frequency of thickness measurement as stated above shall be initially on every pipe up to at least 100 pipes but may be reduced depending upon the consistency of result to one pipe in every ten (10) instead of every pipe, at the sole discretion of the COMPANY Representative. Results of all measurements shall be recorded.



10.4.5 Thickness of epoxy and adhesive shall be measured at the beginning of each shift and whenever the plant re-starts after any stoppage for compliance. Coating of epoxy and adhesive on portion of pipe required for this purpose, stripping and recoating of such partly coated pipes shall be at CONTRACTOR's expense.

10.4.6 Coated pipes not meeting the above requirements shall be rejected. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at CONTRACTOR's expense.

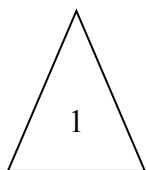
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10.5 Holiday Detection

10.5.1 Each coated pipe length shall be checked over 100% of coated surface by means of a "holiday detector" of a type approved by COMPANY for detecting holidays in the finished coating.

10.5.2 The holiday detector shall be a low pulse D.C. full circle electronic detector with audible alarm and precise voltage control complying with ISO 21809-1. The set voltage for inspection shall be minimum 25 kV. The operating voltage between electrode and pipe shall be checked at least twice per working shift, and shall be maintained at 25 kilovolts.



10.5.3 CONTRACTOR shall demonstrate to the COMPANY that setting of the detector is satisfactory for detecting pin holes. CONTRACTOR shall calibrate the holiday detector at least once every 4 hours of production. CONTRACTOR shall have necessary instruments or devices for calibrating the holiday detector. The correct travel speed shall be determined by consistent detection of an artificial pinhole made in a good coating sample but shall not exceed 300 mm/s.

10.5.4 Any pipe coating shall be rejected if more than 1(one) holiday & area more than 100 cm² in size are detected in its length attributable to coating process.


10.5.5 Holidays which are lesser in size than those mentioned in para 10.5.4 above, shall be repaired in accordance with a approved procedure and shall be at CONTRACTOR's expense.

10.5.6 If there is an excess occurrence of holidays on successive pipes, the CONTRACTOR shall immediately stop the coating operation to determine the cause and remedy it.

10.6 Adhesion Test

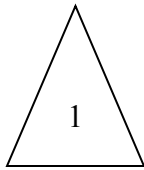
10.6.1 The coating adhesion shall be determined in accordance with either of the methods described in DIN 30678. The test shall be performed at 90°C, 110°C and 120°C in accordance with NF A 49-711.

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10.6.2 Minimum adhesion strength shall be in accordance with DIN 30678, 80 Newton per centimetre width of strip peeled at 90°C and 40 Newton and 30 Newton per centimetre width of strip peeled at 110°C and 120°C respectively in accordance with NF A 49-711.

10.6.3 The frequency of test for cut back portions shall be one pipe in every fifteen (15) pipes coated and for middle of pipe shall be one pipe in every sixty (60) pipes coated or one pipe per shift whichever is higher. On each selected pipe, adhesion test shall be performed for each specified temperature. Test shall be performed at each cut back portion and one in the middle of pipe. The failure mode shall be recorded for each test.



10.6.4 The frequency of adhesion test as per para 10.6.3 for cut back portion may be reduced depending upon the consistency of result to one pipe in every twenty five (25) instead of every fifteen pipes, at the sole discretion of the COMPANY Representative.

10.6.5 During adhesion testing, samples of coating shall be examined using 30X microscope for air entrapment on the body of the pipe as per para 10.10.

10.7 Penetration or Indentation Test

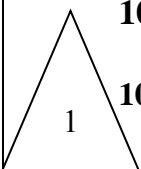
10.7.1 Three samples shall be cut from each of four pipes and tested for resistance to indentations in accordance with the method stated in NF A49-711. The test shall be performed at temperatures of 23°C and 110°C.

10.7.2 Maximum penetration depth exhibited after testing shall not exceed 0.1 mm at 23°C and 0.4 mm at 110°C.


10.7.3 The frequency of test shall be initially 2 (two) coated pipes per shift which shall be further reduced to one test each on 2 coated pipes per week at random after 1 week of consistently acceptable results. Two samples for each temperature shall be taken from the cut back portion of coated pipe and one in the middle of the pipe for this test.

10.8 Impact Test

10.8.1 A sample of coated pipe shall be impact tested in accordance with the procedures specified in DIN 30678. Tests shall be performed at a temperature of 23°C.



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10.8.2 Acceptance criteria for the number of blows per coating breakdown shall be as detailed in both DIN 30678.

10.8.3 Initially the frequency of test shall be two (2) coated pipes per shift that may be further reduced to one coated pipe per 2 weeks depending upon consistently acceptable results at the sole discretion of COMPANY's Representative.

10.9 Cathodic Disbondment Test


Cathodic disbondment testing shall be performed for 48 hours at an electrolyte temperature of 95°C. The acceptance criteria shall be 7 mm maximum disbondment from the edge of the pre-drilled hole. The test shall be performed in accordance with NF A49-711. The frequency of this test shall be once in every two weeks or one test representing each batch of epoxy powder used, whichever is more frequent.

In case the test fails to conform to the specified requirement, at the option of the CONTRACTOR, all pipes coated after the previous acceptable test and prior to next acceptable test shall be rejected or the test shall be repeated using two additional samples taken from the same end of the affected pipe. When both retests conform to the specified requirement, the lot of pipes shall be accepted. When one or both the retests fail to conform to the specified requirement, all coated pipes after previous acceptable test and prior to next acceptable shall be rejected. All rejected pipes shall be stripped, re-cleaned and re-coated. COMPANY may consider a further retest program to determine whether any of the affected pipe meet the criteria for acceptance upon written request by the CONTRACTOR.

10.10 Air Entrapment Assessment

10.10.1 No more than 10% of the observed area shall be taken with air entrapment (porosity or bubbles). Bubble size in the polypropylene layer shall be limited to less than half the thickness of polypropylene layer in height or circumference. Bubbles shall not link together to provide a moisture path to the adhesive/FBE layers.

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10.10.2 The strips of coating from the adhesion test should be studied to determine the level of air entrapment at the failure interface. This same area can be used to determine the air entrapment by cutting the coating at 45° angle along the edge of the remaining coating on the pipe at the test area.

10.10.3 See Appendix 3 for Air Entrapment Assessment.

10.11 Degree of Cure

A thermal analysis shall be carried out using a Differential Scanning Calorimeter (DSC). Epoxy film samples shall be removed from the coated pipe using hammer and cold chisel. This produces furled coating flakes. Care shall be taken to remove samples of full film thickness but at the same time avoid the inclusion of steel debris and contamination with adhesive or polypropylene. The sample shall be tested for cure using DSC procedure. The glass transition temperature differential (ΔT_g) and % cure shall be the test used to verify cure along with a visual examination to ensure no residual cure in the portion of the graph beyond the glass transition temperature. The required cure characteristics are:

$$\Delta T_g = -2^{\circ}\text{C to } +3^{\circ}\text{C } (\Delta T_g = \Delta T_g \text{ final} - \Delta T_g \text{ initial})$$

Only a 95% minimum cured coating shall be acceptable.

$$\% \text{ Cure} = \frac{(\Delta H - \Delta H \text{ residual})}{\Delta H} \times 100$$


(ΔH = Exothermic heat of reaction of FBE powder,

ΔH residual = Exothermic heat of reaction of applied epoxy film).

Frequency of this test shall be once per shift. Pipe shall be selected randomly by COMPANY Representative during the middle of a shift. Suitable provisions/ arrangements as per the instructions of COMPANY Representative shall be made by the CONTRACTOR for this purpose.

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

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10.12 Destructive Tests

10.12.1 For coating destructive tests listed in Appendices 1 and 2, a sufficient length of production pipe shall be cold cut to provide the required number of samples for testing.

10.12.2 The coating on the cut end of the pipe length shall be cut back to comply with para. 9.3.5 of this specification.

10.13 Test Failure


10.13.1 In the event that a production coated pipe fails to meet the acceptance criteria for a specified test, the CONTRACTOR shall test the preceding and succeeding coated pipe. If both pipes pass the test, then the remainder of the pipe lengths in that shift shall be deemed satisfactory. If either pipe fails to meet the specified requirements, all pipes coated during that shift shall be tested until the coating is proved acceptable. Rejected coated pipes shall be stripped and re-coated in accordance with approved procedure, at CONTRACTOR's expense.

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

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

Under no circumstances any action or omission of the COMPANY's Representative shall relieve the CONTRACTOR of his responsibility for material and quality of coating

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produced. No pipes shall be transported from the coating plant unless authorized by COMPANY in writing.

11.0 HANDLING, TRANSPORTATION AND STORAGE OF PIPES

11.1 Contractor shall develop the method of stock piling and loading out bare and coated pipes and shall receive approval from Company's Representative prior to handling coated pipes.

11.2 The Contractor shall unload, load, stockpile and transport the bare pipes using suitable means and, in a manner, to avoid damages to pipes. Pipe shall not be allowed to drop or strike objects which will damage the pipe but shall be lifted or lowered from one level to another by suitable equipment, preferably by vacuum lifting equipment. Lifting hooks when used, shall be equipped with a plate curved to fit the curvature of the pipe. In loading pipe on trucks each length shall be lowered to position without dropping and each succeeding length shall rest on special supports on the truck and shall be separated from the adjacent pipes. After loading, suitable chains and padding shall be used to tie the load securely to each bolster. Pipe, when stock piled, shall be placed on suitable skid to keep it clear of the ground and flood water. Care shall be exercised in handling or stock-piling pipes in order to avoid distortion, flattening, denting or other damages. The Contractor shall provide all necessary timber or other materials required for the stock-piling. While stacking, the number of allowable layers of bare pipes shall be calculated as per API RP 5L 1 and shall be agreed with the Company. The stacks must be properly secured against sliding and shall consist of pipes of the same diameter and wall thickness. Adjacent stacks of pipes having different dimensional characteristics shall be clearly separated. Bare / coated pipes at all times shall be stacked completely clear from the ground, at least 300 mm, so that the bottom row of pipes remains free from any surface water. The pipes shall be stacked at a slope so that driving rain does not collect inside the pipe. Bare / coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can be of dry, germ-free straw covered with plastic film, otherwise foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes.

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11.3 Contractor shall load out the coated pipes onto rail-car or trucks and barges and shall furnish special loading spacers, bolsters and the like, approved by the Company's Representative, to protect the pipe during transport.

11.4 Coated pipe shall be handled at times with wide non-abrasive or leather belts or other equipment designed to prevent damage to the coating. All such equipment shall be kept in proper working order so as to prevent injury to the coating. The use of tongs, bare pinch bars, chain slings, protruding rivets, pipe hooks without proper padding, or any other handling equipment that may be injurious to the coating shall not be permitted.

11.5 Yard coated pipe shall be raised or lowered to or from stock pile, ground, barge, rail car or truck by means of brass lined or padded pipe end hooks engaging the ends of the pipe and carried by wire rope on chain slings with "spreader bars" between lifting lines. The bolster of the trailer or barge shall have a bearing surface not less than 300 mm wide to give necessary support to the padding which protects the coating.


Sacks partly filled with sand or saw dust shall be placed on the bolster and between the outside bottom pipes and bolster stacks. All chains, cables or other equipment used for fastening shall be padded.

11.6 The maximum stack height for various types of coated pipes shall be limited to such heights as will not cause damage to the pipe and coating. The stacking shall conform to the requirements of API RP 5L 1 and API RP 5L 5. Only coated pipes of same outside diameter and wall thickness shall be nested together.

11.7 All pipes shall be tightly nested (laid parallel with full length in contact). Corrosion coated pipes shall not be loaded, piled or nested with the concrete coated pipes.

11.8 In case of any marine transportation of bare/coated line pipes involved, the same shall be carried out in compliance with API RP 5LW. CONTRACTOR shall furnish all details pertaining to marine transportation including drawings of cargo barges, storing / stacking, sea fastening of pipes on the barges / marine vessels to the company for approval prior to undertaking such transportation works. In addition, contractor shall also carry out requisite analysis considering the proposed transportation scheme and establish the same

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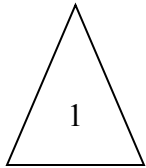
is safe and stable. On-deck overseas shipment shall not be allowed.

11.9 Material Control Records

11.9.1 CONTRACTOR shall record the receipt; issue return or disposal of all materials supplied by COMPANY and shall permit inspection of those records by COMPANY at all reasonable times. In particular, the records shall reference the pipe number of each pipe.

11.9.2 CONTRACTOR shall submit details of material control recording procedure to COMPANY for review prior to commencement of the works.

11.9.3 CONTRACTOR shall submit details of his traceability procedure for COMPANY's review and approval. Before blasting outside pipe details shall be transferred inside at both ends of the pipe. After coating & final inspection, required pipe information shall be marked at external cutback area in order to retain traceability even after concrete coating.




11.9.4 A detailed procedure for marking and transferring the full traceability of the pipe from the bare pipe to the external surface of the coated line pipes after coating shall be submitted to the COMPANY for review and approval. Material Test Certificates and MANUFACTURER Test Reports shall be traceable to each pipe within the APPLICATOR's Coating Book, which shall be part of the QC Data Book.

11.9.5 All coated line pipes shall be provided with full traceability details stencilled on the external surfaces of the coated pipes as per para 11.9.3 above.

12.0 REPAIR OF COATING

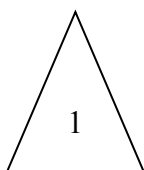
CONTRACTOR shall submit to COMPANY, its methods and materials proposed to be used for executing a coating repair and shall receive approval from COMPANY prior to use. In open storage the repair coating materials must be able to withstand a temperature up to (+) 120°C without impairing its serviceability and properties. CONTRACTOR shall furnish manufacturer's test certificates for the repair materials clearly establishing the compliance of the repair materials with the applicable coating requirements indicated in this specification.

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

Defects, repairs and acceptability criteria shall be as follows:




- Pipes showing porosities or very small damage not picked up during holiday test and having a surface less than 0.5 cm² or linear damage (cut) of less than 3 cm shall be repaired by melt stick using material of same quality.
- Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2 mm and an area not exceeding 20 cm² shall be rebuilt by repair patch only and without exposing to bare metal.
- Defects of size exceeding above mentioned area or holidays of width less than 300 mm shall be repaired with repair patch by exposing the bare metal surface.
- Defects exceeding the above and in number not exceeding 2 per pipe and linear length not exceeding 500 mm shall be repaired using heat shrinkable sleeves.
- Pipes with bigger damage shall be stripped and recoated.
- In case of coating defect close to coating cut back, CONTRACTOR shall remove the coating throughout the entire circumference of the pipe down to the steel surface and increase the coating cut back length. Now if the coating cut back exceeds 140 mm of linear length of pipe, then the coating shall be repaired by the use of heat shrink sleeves thereby making up the coating cut back length of 120 mm.

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

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

- Holiday repair of size ≤ 100 cm² attributable to process of coating application shall be maximum one number per pipe.
- In addition to the above, defects to be repaired by patch / heat shrink sleeve shall be

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maximum 2 (two) per pipe.

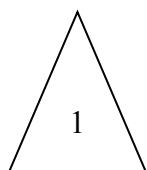
Defects exceeding the above limits shall cause pipe coating rejection, stripping and recoating. The above is exclusive of the repairs warranted due to testing as per this specification.

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

Cosmetic damages occurring in the polypropylene layer only need not be repaired by exposing up to steel surface, as deemed fit by the COMPANY Representative. In any case the CONTRACTOR shall establish his material, methods and procedure of repair that result in an acceptable quality of product by testing and shall receive approval from COMPANY prior to use.

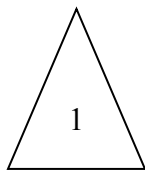
Inspection and Testing of coating repair shall be done as follows:

- Visual: Repaired area shall be aesthetic in appearance and it shall be free of void, gap, bubbles and other visible surface defects.
- Thickness: the thickness shall not less than the parent coating thickness or as per as-supplied product thickness, recommended by material manufacturer.
- Holiday Detection: Each repaired area shall be subjected to holiday detection at a voltage of 5 kV/mm (+5 kV) or at a maximum of 25 kV, according to the method defined in Annex C of ISO 21809-3.
- Repaired area shall be free of holidays or other discontinuities.




All repairs shall result in a coating thickness no less than the parent coating thickness. CONTRACTOR shall test repairs to coating as and when required by COMPANY.

13.0 MARKING



CONTRACTOR shall place marking on the outside surface of the coating at both cutback ends of the coated pipe, and marking shall indicate, but not limited to the following information:

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- Pipe number, Heat number
- Diameter & Wall thickness
- Coated pipe number
- Colour band
- Any other information considered relevant by COMPANY.
- Pipe Manufacturer Name
- Inspection Mark/Punch

CONTRACTOR shall obtain prior approval on marking procedure to be adopted from the COMPANY.

14.0 QUALITY ASSURANCE

14.1 The CONTRACTOR shall have established within his organization and, shall operate for the contract, a documented Quality System that ensures that the requirements of this specification are met in all aspects. The Quality System shall be based upon ISO 9001 or equivalent.


14.2 The CONTRACTOR shall have established a Quality Assurance Group within its organization that shall be responsible for reviewing the Quality System and ensuring that it is implemented.

14.3 The CONTRACTOR shall submit the procedures that comprise the Quality System to the COMPANY for agreement.

14.4 The CONTRACTOR's Quality System shall pay particular attention to the control of Suppliers and Sub-contractors and shall ensure that the requirements of this specification are satisfied by the Suppliers and Sub-contractors operating Quality system in their organization.

14.5 The CONTRACTOR shall, prior to the commencement of work, prepare and issue a Quality Plan for all of the activities required to satisfy the requirements of this specification. The plan shall include any sub-contracted work, for which the sub-contractors Quality Plans shall be submitted. The plan shall be sufficiently detailed to

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indicate sequentially for each discipline the requisite quality control, inspection, testing and certification activities with reference to the relevant procedures and the acceptance standards.

- 14.6** The CONTRACTOR's Quality system and associated procedures may, with due notice, be subject to formal audits. The application of quality control by the CONTRACTOR will be monitored by the COMPANY Representatives who will witness and accept the inspection, testing and associated work required by this specification.

15.0 DOCUMENTATION

APPLICATOR shall submit the type and quantity of details and documentation for CONTRACTOR's authorization or information as listed in the individual Material Requisitions and Purchase Orders.


Reports shall be kept of all relevant data for each item coated. This shall include, but not be limited to the following:

- Material batch numbers and certificates detailing all the information required for each batch as defined in this specification
- Details of blasting abrasive, measurement of surface profiles, surface preparation standard and recording of environment conditions prevailing during blasting
- Recording of steel surface defects and repairs
- Surface temperature of items prior to coating
- Results of all tests as defined in this specification
- Details of repairs to coating defects exposed during testing and the repair techniques used
- Details of rejected items, with reasons for failure
- Information on items which, after rejection, require complete recycling

Such information shall be submitted daily by the APPLICATOR to the CONTRACTOR. Absence of documentation shall be considered a just cause for rejection of coating system.

The following documentation, written in the English Language, shall be submitted to

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COMPANY for review.

Prior to the start of Production Operations, CONTRACTOR shall submit the following documentation to the COMPANY:

- Production Schedule
- Coating and Testing Procedures
- Detailed Description of Coating Equipment and Materials
- Pipe Handling Equipment Description and Procedures
- Pipe Stacking Arrangements
- Material Control Recording Procedure
- Inspection and Testing Plan
- Repair Procedure


CONTRACTOR shall submit to COMPANY the following documentation prior to the return of coated pipe to COMPANY:

- Mill Certificates for Line Pipe Received
- MANUFACTURER's Certificates for Each Batch of Coating Materials
- Certification / Calibration Certificates for all Testing and Coating Equipment
- Inspection and Test Records, Results, and other Documentation of all Material and Coating Tests
- Certificate of conformance and dimensional check report
- Verification certificates for standard compliance
- All concession requests

All reports shall be signed by CONTRACTOR to signify compliance with the requirements of this specification.

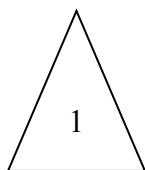
Inspection Certificate (in accordance with EN 10204 3.2) should be a part of final documentation.

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16.0 PREPARATION FOR SHIPMENT

The CONTRACTOR shall submit shipping and handling procedures to the COMPANY for approval. The procedures should adequately address storage, shipping and handling in view of the long voyage from manufacturing locations and climatic extremes at the job site.



An appropriate design of end cap shall be fitted to each opening to protect the butt weld ends and prevent ingress of foreign material. Handling shipping and storage procedure shall incorporate requirements given in API RP 5LW and API RP 5L1.

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ANNEXURE-I

LIST OF ACCEPTABLE COMBINATIONS OF COATING MATERIALS


The following combinations of coating materials' manufacturers are considered acceptable.

In case any of the combinations listed below are offered, details regarding the offered materials and its properties need not be furnished with bid. However, In the event of award of contract, manufacturer's trade name and data sheets/ properties for each coating material proposed by the CONTRACTOR and compatibility certificate for the proposed combination (s) from the raw materials Manufacturers, shall be submitted for COMPANY's approval prior to the placing of any order for coating work.

	Epoxy Powder (Manufacturer)	Adhesive (Manufacturer)	PP Compound (Manufacturer)
1	JOTUN	DUPONT	DUPONT
	or	or	or
	BASF (ARSONSISI)	LYONDELL BASELL	LYONDEL BASELL
	or	or	or
	3M	BOREALIS	BOREALIS

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


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APPENDIX 1: INSPECTION SUMMARY FOR PROCEDURE QUALIFICATION TEST ON PP COATING SYSTEM FOR ONE PIPE DIAMETER

1 Property	Relevant Clause	Acceptable Values	Number of Tests
<u>Before Cleaning</u> <ul style="list-style-type: none"> Pipe Condition 	8.2	Conditions A&B of ISO 8501 (part I)	5 pipes
<u>After Cleaning</u> <ul style="list-style-type: none"> Cleanliness Profile Chloride Oil contamination Degree of Dust Wall thickness (after grinding of defects, if applicable) 	8.7 8.7 8.6.5 8.3 8.7 8.10	Sa 2½ 50 - 80 µm Max. 2 µ gram/cm ² No indications of oil contamination Quality Rating 2 or Class 2 of ISO 8502-3 ≥ 95% of specified thickness (pipes with ground areas > 50 mm in dia. shall be re-blasted)	5 pipes 5 pipes 15 (3X5 pipes) 5 pipes 5 pipes Each pipe after grinding / repair
<u>Coating Thickness</u> <ul style="list-style-type: none"> FBE coated FBE + Adhesive FBE + Adhesive + PP 	7.5.1(b) 7.5.1(c) 10.4	350 µm - 500 µm 600 µm - 900 µm Pipe DN up to 150 mm = min. 2.5 mm. Pipe above DN 150 mm & upto 300 mm = min. 3.0 mm. Pipe above DN 300 mm = min. 3.5 mm.	12 (12x1 pipe) 12 (12x1 pipe) 48 (12x4 pipes)
<u>Visual Examination</u> <ul style="list-style-type: none"> Partly Coated Pipe FBE + Adhesive + PP 	7.5.3 10.3	Smooth with no surface defects Smooth with no surface defects	1 pipe 4 pipes
<u>Holiday Inspection</u> <ul style="list-style-type: none"> Partly Coated Pipe FBE + Adhesive + PP 	7.5.1(d) 10.5	Max. 1 no. & area up to 100 cm ² in size per pipe length Max. 1 no. & area up to 100 cm ² in size per	1 pipe 4 pipes


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Property	Relevant Clause	Acceptable Values	Number of Tests
		pipe length	
<u>Adhesion</u> <ul style="list-style-type: none"> Partly Coated Pipes FBE + Adhesive + PP 	7.5.1(e) ii. 7.5.1(e) i. 10.6 & 7.5.2 (a)	Refusal to peel or a cohesive failure Rating 2 Min. 80 N/cm at 90°C, 40 N/cm at 110°C, 30 N/cm at 120°C	1 pipe 1 pipe 9 (3x3 pipes) at each specified temp.
<u>Cathodic disbondment</u> <ul style="list-style-type: none"> FBE + Adhesive + PP 	7.5.2 (e)	Max. 5 mm at 23°C / 28 days. Max. 6 mm at 65°C / 48 hours Max. 7 mm at 95°C / 48 hours	1 Random pipe 1 Random pipe 1 Random pipe
<u>Impact Resistance</u> <ul style="list-style-type: none"> Partly Coated Pipes FBE + Adhesive + PP 	ASTM G14 & API RP 5L9 7.5.2(b)	2J (minimum) at 23±2°C ≥ 10J/mm (30 impacts) (See DIN 30678)	1 pipe 3 Random pipes
<u>Penetration or Indentation Hardness</u>	7.5.2(c)	Max. 0.1 mm at 23°C; Max. 0.4 mm at 110°C	12 (3 x4 pipes) 12 (3 x4 pipes)
<u>Degree of Cure</u> <ul style="list-style-type: none"> Partly Coated Pipes FBE + Adhesive + PP 	7.5.1(a) 7.5.2(i)	-2°C ≤ ΔT _g ≤ +3°C 95% min. cured coating -2°C ≤ ΔT _g ≤ +3°C 95% min. cured coating	4 (4x1pipe) 4 Random (4x1pipe)
<u>Flexibility / Bend Test</u> <ul style="list-style-type: none"> Partly Coated Pipes 	See Appendix 4 & 7.5.1(f)	API RP 5L9 at 0°C & 20°C No cracking / disbondment / pinholes	3 (3x1pipe) at each specified temp.
<u>Air Entrapment</u> <ul style="list-style-type: none"> FBE + Adhesive + PP 	7.5.2(h)	Max. 10% (Rating 1) air entrapment in pipe or cut back	8 (2x4pipes)

Number of Tests can be increased at the sole discretion of COMPANY.


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APPENDIX 2: INSPECTION SUMMARY FOR PRODUCTION TESTING ON FULL PP COATING SYSTEM FOR ONE PIPE DIAMETER

1	Property	Relevant Clause	Acceptable Values	Minimum Frequency*
	<u>Before Cleaning</u> • Pipe Condition	8.2	Conditions A&B of ISO 8501 (part I)	Each Pipe
	<u>After Cleaning</u> • Cleanliness • Profile • Chloride • Oil contamination • Degree of Dust • Wall thickness (after grinding of defects, if applicable)	8.7 8.7 8.6.5 8.3 8.7 8.10	Sa 2½ 50 - 80 µm Max. 2 µ gram/cm ² No indications of oil contamination Quality Rating 2 or Class 2 of ISO 8502-3 ≥ 95% of specified thickness (pipes with ground areas > 50 mm in dia. shall be re-blasted)	Each pipe 1 per 50 pipes 1 per 100 pipes at 2 locations 1 per 100 pipes 1 per 100 pipes Each pipe after grinding / repair
	<u>Coating Thickness</u>	10.4.3	Pipe DN up to 150 mm = min. 2.5 mm. Pipe above DN 150 mm & upto 300 mm = min. 3.0 mm. Pipe above DN 300 mm = min. 3.5 mm.	(At 12 locations) Each pipe upto 100 pipes & 1 per 10 pipes on getting consisting results
	<u>Holiday Inspection</u>	10.5	No Holidays	Each Pipe
	<u>Visual Examination</u> • Surface of coating • Cut backs	10.3 9.3.5	No surface defects 120 (+) 20/ (-) 0 mm width, bevel 30° to 45° (Note 1)	Each Pipe Each Pipe

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Property	Relevant Clause	Acceptable Values	Minimum Frequency*
<u>Adhesion</u> <ul style="list-style-type: none"> At 90°C At 110°C At 120°C 	10.6 10.6 10.6	Min. 80 Newton / cm width of strip peeled Min. 40 Newton / cm width of strip peeled Min. 30 Newton / cm width of strip peeled	For cut-back: 1 per 15 pipes & 1 per 25 pipes on getting consisting results For middle of pipe: 1 per 60 pipes & 1 per shift whichever is higher on getting consisting results
<u>Cathodic disbondment</u> <ul style="list-style-type: none"> At 95°C/ 48 hours 	10.9	< 7 mm radius of disbondment	Once per 2 weeks or one test per batch of epoxy powder whichever is more
<u>Impact Resistance</u> <ul style="list-style-type: none"> 30 impacts at 23±2°C 		10J/mm (minimum) See DIN 30678	2 pipes per shift & reduced to one pipe per 2 weeks on getting consisting results
<u>Penetration or Indentation Hardness</u>	10.7	Max. 0.1 mm at 23°C; Max. 0.4 mm at 110°C	2 pipes per shift & reduced to 1 test each on 2 coated pipes per week on getting consisting results
<u>Degree of Cure</u>	10.11	2°C ≤ ΔT _g ≤ +3°C 95% min. cured coating	Once per shift
<u>Air Entrapment</u>	See Appendix 3 and 10.10	Max. 10% (Rating 1) air entrapment in pipe or cut back	Once per shift

Note:

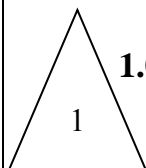
- The cut back length shall be 150 (+)20/ (-)0 mm width, bevel 30° to 45° if specified by purchaser (in case of Automatic Welding and AUT)

*COMPANY reserves the rights to increase inspection and testing frequency if warranted by the circumstances.

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APPENDIX 3: AIR ENTRAPMENT ASSESSMENT



1.0 Scope

To determine the amount of cross section and interface air entrapment (porosity or bubbles in the plant applied coating).

2.0 Equipment

2.1 Microscope - Hand Held 30 X.

2.2 Utility knife.

3.0 Test Specimen

Strips from Adhesion Tests, coating disbondment (CD) test samples, and coated pipe may all be used to help determine the rating.

4.0 Procedure

4.1 Adhesion strip shall be viewed from the side ant the failure interface.

4.2 Cathodic disbondment samples shall be viewed from the side before tests begins. Scraping with a sharp knife to remove cutting damage on the edge of the coating may be necessary to provide a smooth surface for viewing.

4.3 At the pipe adhesion test site use a utility knife to cut the edge of the coating to a 45° angle and view with a microscope.

4.4 Perform a similar test in the cut back area. This should be used for information to determine if further testing is needed.


5.0 Reporting and Grading

5.1 Report pipe joint number, date pipe was coated, coating batch number, and date of test.

5.2 Report rating of cross-section and interface entrapment.

5.3 A rating of 1 is passing.

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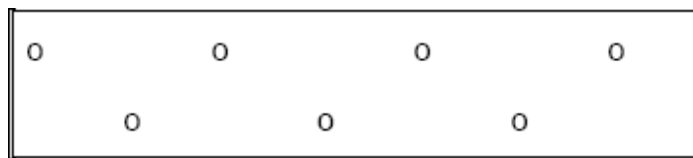
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Rating will be on a scale of 1 to 5 as follows:

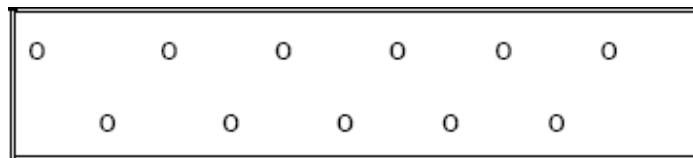
Rating

1. Very Good – Passing
2. Good – Passing
3. Fair – Failing
4. Poor – Failing
5. Very Poor – Failing

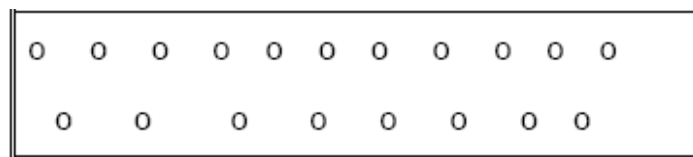
Rating for each area of concern:



No. 1 Rating – Passing Less than 10% of area with bubbles




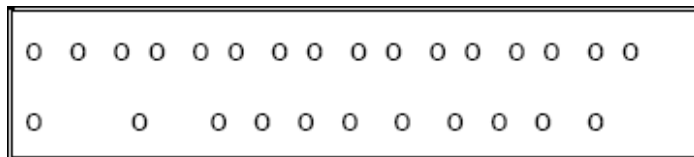
No. 2 Rating – Passing Less than 20% / more than 10%



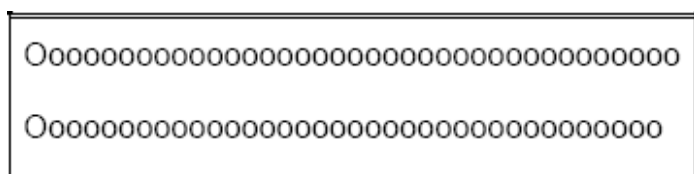
No. 3 Rating – Passing Less than 30% / more than 20%

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No. 4 Rating – Passing Less than 40% / more than 30%



No. 5 Rating – Failing Over 50% of area taken by air entrapment
(bubbles)

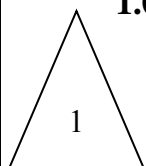
By looking at the top (outside) surfaces the same type rating system can be used.

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APPENDIX 4: FOR FBE LAYER COATING PQT

1.0 Test Method



The flexibility of the coating shall be determined once on the first day of production of only FBE layer coated pipes (1 No.) by the following method:

Coated samples (200 mm x 25 mm x thickness of pipe wall) taken from a FBE coated pipe joint shall be subjected to a bend test at a temperature of 0°C and 20°C to induce 2% and 3% strain respectively in the sample.

At each temperature the test shall be carried out twofold.

The deflection loading rate during bend testing shall be 25 ± 2 mm/min.

The mandrel sizes shall be selected according to the following formula:

$$D = t(1-s)/s$$

D = mandrel diameter (mm)

t = specimen wall thickness (mm)


s = 0.02 at 0°C

0.03 at 20°C

2.0 Acceptance Criteria

The coating shall not exhibit any signs of cracking, disbondment or pinholes.


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FUNCTIONAL SPECIFICATION FOR CONCRETE WEIGHT COATING OF SUBMARINE PIPELINES

Revised By		Peer Reviewed By	Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
T.M.K.	C.S.R.	R.P.	S.K.	M.S.	18	17.02.22	2

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1.0 SCOPE



This specification covers the minimum requirements for qualification, application, testing and handling required for application of reinforced concrete coating externally to pre-coated pipe for use in Submarine Pipeline Systems.

2.0 REFERENCE DOCUMENTS


Reference has been made in this specification to the latest editions of the following Codes and Standards



- | | | | |
|----|-------------------|---|--|
| a) | ASTM A641 | : | Zinc Coated (Galvanized) Carbon Steel Wire) |
| b) | ASTM A1064 | : | Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| c) | ASTM C33 | : | Concrete Aggregates |
| d) | ASTM C39 | : | Compressive Strength of Cylindrical Concrete Specimens. |
| e) | ASTM C40 | : | Organic Impurities in Sands for Concrete |
| f) | ASTM C138 | : | Unit Weight Yield and Air Content (Gravimetric) of Concrete. |
| g) | ASTM C150 | : | Portland Cement |
| h) | ASTM C309 | : | Liquid Membrane Forming Components for Curing Concrete. |
| i) | ASTM C642 | : | Specific Gravity, Absorptions and Voids in Hardened Concrete. |
| j) | BS-1881, Part-116 | : | Methods of Testing Concrete for Strength |
| k) | DNV, 1981 | : | Rules for Submarine Pipeline Systems |
| l) | ISO 21809-5 | : | External coatings for buried or submerged pipelines used in pipeline transportation systems — External concrete coatings |



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

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3.0 MATERIALS

3.1 Cement

Portland cement in accordance with ASTM C-150 Type-III shall be used. The Tricalcium Aluminate content shall be within the range of 5% to 8%. Cement which has hardened partially set or lumpy shall not be used.

3.2 Fine Aggregate

Fine aggregate comprising of natural or manufactured sand used shall conform to the requirements of ASTM C-33 and shall be clean, free from injurious amounts of salt, alkali, deleterious substances or organic impurities. Maximum particle size shall be 4.75 mm and minimum particle size shall be 0.15 mm. Each source of sand shall be tested for organic impurities as per ASTM C-40 and approved by COMPANY prior to its use.

3.3 Coarse Aggregate

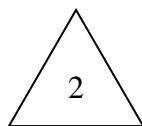
Coarse aggregate consisting of gravel, broken stone, etc., in compliance with ASTM C-33 shall be used. It shall be free of clay and injurious amounts of alkali, deleterious substances and organic impurities that may affect the strength of the concrete. Maximum particle size shall be 9.5 mm and the minimum particle size shall be 0.15 mm.

Iron or barium ore aggregates of a type approved by COMPANY may be mixed with coarse aggregate to obtain the required concrete density.

3.4 Water


Water used shall be clear, fresh and clean and shall not contain chloride and sulphates. Water from each source shall be tested prior to its use and shall be approved by COMPANY. Sea water or contaminated water shall not be used.

3.5 Reinforcement



Reinforcement steel shall consist of welded steel wire mesh manufactured in rolls conforming to ASTM A-1064. Steel wires shall conform to ASTM A-1064. Steel wires shall be galvanized at finished size as per ASTM A- 641. Reinforcement mesh shall be 25 mm x 67.5 mm size and steel wire shall be of $\phi 1.8$ mm. A sample of reinforcement shall be furnished to the COMPANY for approval.

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4.0 COATING REQUIREMENT

Pipes shall be coated with concrete to a thickness and dry density as specified in the Contract document. The compressive strength of concrete shall not be less than 328 kg/cm² in 28 days and 246 kg/cm² in 7 days. Acceptable tolerance on concrete density shall be +5% and -2%. The concrete coating shall not absorb water more than 4% of its weight in water.

5.0 EQUIPMENTS

The mechanical equipment used for performing the concrete coating shall be capable of doing so with a required degree of uniformity with respect to thickness, density and strength. The proportioning equipment and procedure shall ensure consistently proportioned materials by weight and thorough mixing of all materials. Equipment shall have either the batching of materials by weight or continuous mixing, where all feeds are accurately controlled and percentages of mixer calibrated by weight. Batching scales/weighing devices shall be maintained in good conditions. Proportioning equipment shall be calibrated in the presence of COMPANY REPRESENTATIVE. Any equipment that tends to separate the ingredients shall not be used.

6.0 PROCEDURE QUALIFICATION

6.1 Before commencement of the work, Contractor shall perform all tests either in the laboratory or in the field and trials necessary to properly select type of mix and concrete application procedures.


6.2 The type of mix i.e., the correct combination of the cement, aggregates and water shall be established by taking minimum 5 samples of concrete from each mix. Samples of hardened concrete, not less than 4 days old, shall be tested in accordance with ASTM C-642 to determine the dry specific gravity of the concrete and the saturated weight after immersion.

Test according to ASTM C-138 shall also be performed to determine the expected correlation between the fresh concrete density and dry density.

For each mix the following shall be accurately checked and recorded.

- Proportions & weights of respective materials used.
- Water / cement ratio
- Grading of the aggregates

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6.3 When the results of the above tests do not meet the requirements, the mix shall be modified and concrete samples tested until a proper mix has been determined. The mix so determined shall be then used for sampling of concrete for compressive strength test. For this purpose, minimum 4 cube samples, two each for 7 days strength and 28 days strength shall be tested in accordance with BS 1881 Part-116. Mix complying with the specified dry density, compressive strength is presided as the final mix.

6.4 Subsequent to selection of the mix, trials shall be performed by concrete coating application on lengths to test the placing procedures of the concrete and the following determined.

- Workability to the concrete and pouring or cement gun rates
- Number of passes required to meet the concrete coating thickness as specified.

6.5 Contractor shall furnish the above procedure qualification details in the form of a report to COMPANY for approval prior to application of regular concrete coating.

7.0 MEASUREMENT AND LOGGING

7.1 All measurement as mentioned below shall be taken during the works and logged in a log-book. A special log-book shall be used for recording tests and trial results. A log-book shall refer to pipe lengths having the same nominal diameter and wall thickness.

7.2 The following shall be subject to measurement and logging for each pipe length.


a. Line Pipe

1. Field identification number (F)
2. Mill serial number (M) *
3. Length, m (L) *
4. Weight, kg (BW) *
5. Outside diameter, m (OD) *

b. Corrosion Coating

6. Type of coating (C) **
7. Thickness of coating, mm (CT) **
8. Weight of coated pipe, kg (CW)

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9. Presence of anode (Yes or No) **

10. Date of corrosion coating application (DCC) **

c. Concrete Coating

11. Batch identification number (BN)

12. Date of concrete coating thickness, mm (DC)

13. Average concrete coated thickness, mm (CCT)

14. Wet weight of coated pipe, kg (WW)
(Weight and Date of weighting)

15. Calculated Dry weight of coated pipe, kg (CDW)
(Based on the correlation established
between wet weight and dry weight)

d. Additional Information

(On approved concrete mix at least twice per shift)

16. Dry density of concrete, kg/m³ (DDC)

17. Compressive strength of concrete, kg/cm² (CS1)
(7 Days)

18. Compressive strength of concrete, kg/cm² (CS2)
(28 days)
(On randomly selected coated pipes at the
rate of one out of every 50 pipes coated)

19. Saturated weight of coated pipe, kg (SW)

20. Water absorption, % (WA)

21. Dry weight of coated pipe, kg (DW)


* Date can be obtained from Pipe Mill Tally Sheets

** Date can be obtained from Coating Plant Tally Sheets.

7.3

No concrete placing shall be permitted before items 1 thru 10 listed above have been logged. In addition, each batch/shift shall be identified and logged against cube samples taken for compressive strength and dry density.

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8.0 APPLICATION OF CONCRETE COATING AND REINFORCEMENT

8.1 Application Method

Concrete coating shall be applied by impingement method. This method shall ensure the basic characteristics of concrete in compliance with the minimum requirements of this specification and the Contract Requirements.

8.2 Concrete Mixing

The components of the concrete mix shall be weigh batched before mixing by a proper weight-batcher or a continuous mixer with weigh devices. Weighing devices for each component shall have an accuracy of $\pm 1.0\%$ accuracy shall be used for adding water to the mix. The calibration of the weighing devices and the water meter shall be checked at the beginning of each shift.

The moisture content of the aggregates used shall be such as to maintain a satisfactory control on the water/cement ratio of the concrete mix.

8.3 Pipe length preparation

Prior to placement of reinforcement, the anti-corrosion coating of each pipe length shall be carefully inspected visually and by holiday detectors and if damages are found, they shall be repaired in accordance with the relevant specification issued for this purpose before start of the work. Foreign matters, if any, shall be removed from the surface of the anti-corrosion coating.


8.4 Reinforcement Application

8.4.1 Reinforcement shall be placed around the pipe in such a manner to cover the whole pipe length or sections to be concrete coated. The reinforcement shall not protrude beyond the concrete coating at ends.

8.4.2 Splicing shall be done either by binding with soft steel wire having a dia. of 1.5 mm and an overlap of three meshes or pre-bend the end of the wires on the new roll into hooks and then engage it in the end of the preceding roll and pressed short. Wire fabric in rolls (ribbon mesh) shall be provided with a spiral lap of one mesh.

8.4.3 One layer of reinforcement steel for concrete thickness up to and including 60 mm, two layers of reinforcement for concrete thickness between 61 mm and 120 mm and three layers of reinforcement for thickness beyond 121 mm shall be provided. In case of one layer of reinforcement, it shall be located approximately in the middle of the concrete thickness. In case of two layers of reinforcement, layers shall be located at 1/3rd and 2/3rd of the concrete thickness. In case of three layers of reinforcement, layers shall be located at 1/4th, 1/2th and 3/4th of concrete thickness. Contractor shall demonstrate that

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the procedure used ensured no physical contact between steel reinforcement and the pipe and the reinforcement is placed in position as mentioned above.

- 8.4.4** For the first pipe every shift a water jet shall be used to clear away the freshly placed concrete in the centre of pipe, down to the corrosion coating for an area of approximately 75 mm wide and 200 mm long in the longitudinal direction. Inspection of the exposed area shall be used to confirm that the reinforcement mesh is positioned and overlapped within the concrete as specified. If the reinforcement is not positioned correctly, the pipe shall be rejected and re-coated. Proper adjustment as required shall be inspected in this manner until the position of the mesh is accepted.

Repair of inspection slot shall be carried out as per the provisions of Clause 13.0 of this specification.

8.5 Concrete Placing

- 8.5.1** Concrete shall be placed within 30 minutes from the time of mixing (i.e., after adding water to mix) and shall be handled in such a way to prevent aggregate segregation and excessive moisture loss. Concrete containers shall always be kept clean and free from hardened or partially hardened concrete.

- 8.5.2** Placement of concrete shall be up to the specified thickness in one continuous pass, allowance being made for splices of reinforcement and providing reinforcement in the right location. Concrete shall be projected at high velocity against the external surface of pipe to procedure a hard, tight-adhering coating of the specified thickness.

- 8.5.3** No pass shall be stopped for more than 30 minutes. In case of any interruption beyond 30 minutes, coating shall be removed and entire joint shall be re-coated at no extra cost to COMPANY.

- 8.5.4** Concrete placing shall be completed as quickly as possible. In case excessive evaporation of water from the concrete is expected, exposed surfaces shall be immediately covered. Concreting shall not be done at temperatures below 5°C.

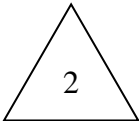
- 8.5.5** Coating at each end of the pipe shall be bevelled to a slope of approximately two-to-one (2:1). Coating shall terminate about 75 mm short of the surface and the fresh concrete shall be washed off at the ends accordingly.

- 8.5.6** Inside and outside surfaces of the uncoated sections of all pipes shall be kept clean and free from cement concrete and grout. Cement concrete and grout. Cement concrete and grout present on said surface after coating completion shall be fully removed before their setting.

- 8.5.7** Bevel protectors shall be reinstalled subsequent to the concreting coating application.

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8.6 Curing



Curing shall be performed by water, steam, sealing compounds or by any other suitable method duly approved by COMPANY. Sealing compounds shall meet the requirements of ASTM C-309. The material shall be prepared and applied to provide complete surface coverage as per the Manufacturer's instructions. The ingredients of any such compound shall be non-toxic and non-inflammable and shall not react with any ingredient of the concrete, the reinforcement the protective coating or pipe. The application of the curing compound shall take place immediately after the coating is completed and preferably before the pipe is removed from the concrete coating apparatus. The surface of the concrete shall be lightly sprayed with water before applying the curing compound. Curing period shall be 7 days. During which period the freshly coated pipes surface shall be kept wet for seven days after application of the concrete coating. Pipes shall not be handled, stacked or loaded out from the yard until so cured. Transportation and handling of concrete coated pipe shall be done only after achieving a minimum compressive strength of 328 kg/cm². Concrete shall be protected from freezing during the curing period.


8.7 Coating of Pipe Joint with Anode Bracelet

Corrosion protection coating on pipe sections where anode bracelets have been installed shall be repaired as per the relevant specification issued for the purpose. After proper curing of repairs to the corrosion coating, the concrete weight coating shall be applied. The anode shall be protected to ensure that no concrete contacts the external surface of the anode bracelet. Wire reinforcement shall terminate a minimum of 50 mm from the anode bracelet. The anode assembly shall not protrude above the concrete coating. If due to any reason concrete thickness is more than anode thickness, concrete shall be tapered to 1:4 to make anode concrete transition smooth

9.0 TOLERANCES

9.1 Contractor shall maintain a tolerance of ± 6 mm on outside diameter of the coated pipes measured by diameter tape. The diameter of each coated pipe shall be obtained at five points, spaced at equal intervals between the end points.

9.2 The acceptable weight tolerance of any single pipe shall be limited to + 5% or – 2% of the calculated weight. Calculated weight shall consider the total weight of pipe with corrosion and concrete coating based on approved concrete density and thickness.

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9.3 Acceptable weight tolerance from the approved mix during production shall be as follows:

- $\pm 3\%$ for each type of aggregate
- $\pm 2\%$ for aggregate as a whole
- $\pm 3\%$ for the total quantity of water
- $\pm 3\%$ for the cement

10.0 WEIGHING

10.1 All weighing of concrete coated pipe lengths shall be performed using suitable weighing device having an accuracy of $\pm 0.5\%$. Calibration of the weighing device shall be carried out daily to the satisfaction of the COMPANY REPRESENTATIVE. Weighing devices used shall have valid certificate regarding the range and accuracy. COMPANY has the option to request calibration at any time during the works.

10.2 Each concrete coated pipe shall be weighed as soon as it is feasible to move it after concrete placing and Contractor shall mark the weight on the inside surface of the pipe with paint followed with letters “WW” meaning Wet Weight.



10.3 Contractor shall weigh one out of every fifty pipes coated when dry prior to shipment (i.e., after achieving 28 days compressive strength) and mark the weight with paint of the inside of the pipe. The weight mark shall be followed with letter “DW” meaning “Dry Weight”.


11.0 INSPECTION AND TESTS

11.1 General

11.1.1 Contractor shall perform all inspection and testing of coated pipes as per the requirements of this specification and relevant codes by qualified inspectors. All equipment, tools, tackles, manpower etc., required for inspection and testing shall be provided by the Contractor. Personnel who, in the opinion of COMPANY REPRESENTATIVE, lack the necessary skill or do not exercise a reasonable degree of care shall not be deployed on the job.

11.1.2 COMPANY reserves the right to perform stage wise inspection and witness tests on all activities concerning the pipe coating operations starting from preparation of mix to finished coated pipe ready for dispatch.

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11.1.3 Contractor shall give reasonable notice of time and shall provide access to every part of the coating yard during all phases of the work and facilities required for inspection to the COMPANY REPRESENTATIVE. Inspection and tests witnessed by COMPANY REPRESENTATIVE shall in no way relieve the Contractor's obligation to perform the required inspection and tests. In case of rate of defective or rejected pipes and/or sample tests are 10% or more for a single shift, Contractor shall be required to stop production and carry out a full and detailed investigation with COMPANY REPRESENTATIVE. Any expense caused by the stopping of work shall be borne by the Contractor. Pipe coating not meeting the requirements of this specification shall be rejected and re-coated by Contractor without any extra charges to COMPANY.

11.2 Inspection of Concrete Coating Materials and Mix

11.2.1 Cement

Test certificates from the Cement Manufacturer shall be supplied to COMPANY REPRESENTATIVE for each batch of cement, prior to its use.

Cement used, is to be identified with the following information on the certification and/or delivery documents for each shipment of cement:



- cement producer's name and location,
- product description including type and classification of cement,
- year and month of production (date of manufacture).

Cement is to be handled, transported and stored prior to use, in compliance with the cement manufacturer's recommendations and in compliance with the applicable standards.


11.2.2 Sand, Aggregate and Water

The grading and purity of sand and aggregate shall be checked at least on alternative days. Purity of water shall be checked at least every week. Report of the above check shall be submitted for COMPANY REPRESENTATIVE's approval.

11.2.3 Proportion of Concrete Material

Tolerance permitted for the mixing proportions shall be checked at least twice per shift. The accuracy of measurement shall be checked at least once per week, taking into account the tolerances allowed for the scales and for the proportion of the materials.

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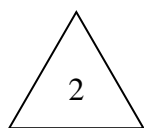
11.3 Testing of Concrete

11.3.1 Daily samples of the concrete mix, as being applied during the coating operation, shall be taken to determine the compressive strength and density of the concrete coating.

11.3.2 Compressive Strength Test

Compressive strength test of concrete used at least twice per shift shall be carried out as per BS 1881 Part-116 on four cubes, two each for 7 days and 28 days strength. Copies of all test reports shall be submitted to COMPANY for approval. If any cube test results do not meet the requirements of this specification, all pipes coated with such concrete batch shall be rejected. Coating on such rejected pipes shall be removed and the pipe recycled for concrete coating.

11.3.3 Density



Dry concrete density of concrete used shall be determined at least twice per shift from hardened and cured concrete not less than 4 days old, taken from sample of coating materials and being applied during normal coating operations in compliance with ASTM C642 with a known specific gravity of water. For this purpose, two samples shall be taken for every batch of concrete used.

11.4 Coated Pipe Inspection and Testing


11.4.1 All pipes shall be visually inspected to detect whether any damages and/or defects are present. Possible damages and/or defects with these allowable limits are mentioned in Clause 12.0.

11.4.2 Diameter and weight shall be checked for each concrete coated pipe. Based on the correlation established between fresh concrete density and dry density during the procedure qualification prior to start of the work, the acceptance of the concrete coated pipes will be made based on the equivalent wet weight of each concrete coated joint immediately after coating.

Pipes exceeding the tolerance limits specified shall be repaired or stripped and re-coated at the discretion of the COMPANY REPRESENTATIVE.

11.4.3 All concrete coated pipes shall be checked to verify insulation between steel reinforcement and pipe by means of a MEGGER or equivalent device.

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11.4.4 At least one out of every 50 concrete coated joints shall be tested for water absorption as follows:

- The concrete coated pipe length shall be weighed in air when dry and the weight recorded as “Dry Weight” (DW)
- The pipe length shall be completely submerged in water of known specific gravity, and so kept for a period as indicated below:

Submerged pipe length shall be weighed at 6 hours interval of continuous submergence till water saturation is reached and the time and weight data recorded. The last weight shall be recorded as “Saturated Weight” (SW). Reaching “Water Saturation” shall mean that the difference between the two last consecutive weighings at 6 hours intervals are not differing more than accuracy of weighting device, as defined at Clause 10.0.

Percentage of water absorption shall be calculated as using following formula and value reported to COMPANY:

$$\text{Water absorption (WA), \%} = \frac{\text{SW} - \text{DW}}{\text{DW}} \times 100$$

COMPANY retains the option of the required additional submerged weight tests in case of any variation from the value established during the procedure qualification.

11.4.5 Shear Test (Push-Off Test)




Shear test shall be performed on cured concrete coated pipe. Once the coating has achieved initial cure, a base plate shall be fitted to the face of concrete and cemented in place, taking care to avoid any air gap. On the pipe itself, a flange shall be welded in place to support the lifting jacks. A series of hydraulic jacks shall be placed between the flange and the base plate. Gradually the force is increased in steps, with a holding period of one (1) minute. Dial gauges are attached to the concrete jacket shall be monitored for any movement.

Pressure shall be increased until a minimum acceptance criterion of 0.3 MPa is achieved. The test shall be continued until the maximum safe working pressure of hydraulic jacks is achieved.

Push off Test set up shall be submitted to the COMPANY for approval and shall include details of safety measures to be taken to avoid injury to personnel.

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12.0 REPAIRS

12.1 The following are repairs that are permitted to coating due to unavoidable damage in handling and storage (This is applicable only to concrete that has hardened).

12.2 Spalling due to compression or shearing caused by impact against other objects. Spalling is defined as damage which causes a loss in concrete of more than 25% of the total thickness of the coating at the point of damage.

12.3 Damage due to spalling of an area of less than 0.1 m² where the remaining concrete is sound and reinforcement steel not exposed, will be accepted without repairs. Damage due to spalling of an area of less than 0.1 m² with reinforcement exposed; and area more than 0.1 m² and less than 0.3 m² shall have the concrete removed as necessary to expose the reinforcing steel throughout the damaged area. Edges of the spalled area shall be undercut so as to provide a key lock for the repair material. A stiff mixture of cement, water and aggregated shall be troweled into and through the reinforcement and built up until the surface is level with the coating around the repaired area at the top and shall be moist cured for a minimum of 36 hours before further handling.


12.4 Should the damaged area be more than 0.3 m², coating shall be removed around the entire damaged area. A repair shall be made by satisfactorily restoring the reinforcement either by forming the area with a metal form pouring complete replacement materials similar to that from which the coating was made or by gunniting with similar concrete. The resulting coating, shall be equal in weight, density, uniformity, thickness, strength and characteristics to the originally applied coating. The pipe shall then be carefully laid in a position where it shall be allowed to remain a minimum of 36 hours before further handling.

13.0 MARKING

13.1 Every concrete coated pipe length shall be clearly marked by a suitable type of paint red or white in colour. Making of concrete coated piping shall be made inside of pipe close to bevel end. The minimum marking requirements shall be as below:

13.2 For each concrete coated pipe length, at one end, the field identification number and the date of concrete placing shall be marked, while the weight along with number of days after coating shall be marked at the other end. In addition, Contractor shall develop a colour coding (band) system to be marked on the outside surface for easy identification of the coated pipe for each concrete coating thickness, concrete density, pipe diameter, pipe thickness and pipe material variation.


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14.0 UNLOADING, TRANSPORT, STORING AND HAULING

- 14.1** Contractor shall unload, load, stockpile and transport the corrosion coated pipes and concrete coated pipes using suitable means and, in a manner, to avoid damage to coating, pipe wall and bevelled ends, from the site of receipt to the coating yard and after concrete coating completion and acceptance to delivery site. The procedure shall be approved by COMPANY prior to commencement.
- 14.2** Damage to pipes which occur after the Contractor has taken delivery such as dents, flats or damage to weld ends shall be cut off or removed and pipes re-bevelled and repaired again as necessary. The cost of this work, as well as that of the pipe lost in cutting and repair shall be to the Contractor's account. All such works shall be carried after written approval of the COMPANY REPRESENTATIVE.
- 14.3** Adequate strapping and padding shall be provided during handling. All pipe handling shall be with equipment approved by COMPANY. All lifting equipment shall be of such a design so as to prevent damage or bump against any other pipe or other objects. Rolling, skidding or dragging shall not be permitted.
- 14.4** Coated line pipes shall be handled at all times with best quality wide nonabrasive slings and belts or end hooks. End hooks shall have sufficient width and depth to fit the inside of the pipe and padded with soft material like rubber, Teflon or equivalent, so as not to cause damages to bevel or pipe ends.
- 14.5** Stacking of coated pipes shall be carried out on surface previously levelled and coated with a layer of soft earth or sand berms to prevent coating from being damaged and water and mud entering inside the pipe. Berms shall generally consist of two rows of roughly trapezoidal shaped mounts. Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes own weight does not cause damages to coating. Contractor shall calculate based on the characteristics of the concrete used, the number of layers for stacking and submit the same of COMPANY for approval.
- 14.6** Stacks shall be suitably secured against falling down and shall consist of pipe section having the same diameter, grade, thickness and concrete coating.
- 14.7** If the COMPANY REPRESENTATIVE observes coating or pipe damage due to handling, Contractor shall review the handling procedure adopted and take corrective actions as required to the satisfaction of the COMPANY REPRESENTATIVE. Damaged pipes shall not be loaded until the repairs in compliance with the requirements of Clause 12.0 are done.
- 14.8** Acceptance of pipes shall be delayed, when pipe lengths having an acceptable concrete coating shows cement concrete, grout, sand, mud, etc. on the inside and on the uncoated surfaces of the pipe or defects on steel pipe especially at bevelled ends till the cleaning and repairing completion.

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- 14.9** Materials other than pipes and which are susceptible of deteriorating or suffering from damages especially due to humidity or other adverse weather conditions, shall be suitably stored and protected.

15.0 DOCUMENTATION


- 15.1** At the time of Bidding, Contractor shall submit the following documents:

- Details of the coating yard, layout, capacity and production rate.
- Facilities in the yard for unloading, handling, transport, production, storage, stockpiling, loading of coated pipes along with the laboratory and equipment details.
- Reference list of previous coating projects carried out giving complete details of diameter, length, concrete coating thickness, concrete density, name of the project, name of client and year.
- Proposed source/list of various materials proposed to be procured for carrying out the coating works.
- A clause-wise list of technical deviations, if any, from the requirements of this specifications. Deviations indicated anywhere else in the offer shall not be considered valid.

- 15.2** Within three weeks of placement of order, the Contractor shall submit four copies of, but not limited to, the following for COMPANY approval.

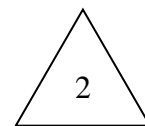
- Proposed procedure for application of concrete coating in compliance with the characteristics and tolerances mentioned in the specification.
- Complete details of raw materials together with Manufacturer's data and test certificates.
- Inspection & testing methods and reporting formats including instruments and equipment types, makes and use etc.
- Dimensional tolerances and control procedures including details of instrument and equipment and calibration methods including relevant standards and examples of calibration certificates.
- Complete details and inventory of laboratory and equipment.
- Sample of recording and reporting formats, including reports and certificates.

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Once the approval has been given by COMPANY, no change shall be made. However, unavoidable changes shall be executed only after obtaining written approval from COMPANY.

15.3 Prior to shipment, Contractor shall submit the following:




- a. Final approved procedure document as established at 15.2 above.
- b. Log sheets as established at 7.2 above.
- c. Histogram of dimensional parameters indicating minimum, maximum, average and standard deviation.
- d. All test results carried out on each batch of concrete and on pipes.
- e. Information on tests failures, rejected batches, etc.

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FUNCTIONAL SPECIFICATION FOR FIELD JOINT COATING (EXTERNAL) OF SUBMARINE PIPELINES

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Total No. of Pages	Date	Rev. No.	
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1.0 SCOPE

This specification covers the minimum requirements of materials, manpower, equipment and application of external field joint corrosion coating and in-fill joint coating of submarine Pipelines and risers. This specification shall be read in conjunction with the requirements of all other specifications and documents included in the Contract. In addition to this specification, wherever stringent, requirements / provisions / amendments of the latest edition of ISO 21809-3; applicable for FJC Type 14A-3 (Table 16) joint coatings shall apply.

2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest editions of the following Standards and specifications:

- a) ASTM D-149 : Standard Test Methods of Dielectric Strength of Solid Electrical Insulating Materials at Commercial frequencies
- b) ASTM D-638 : Standard Method of Test for Tensile Properties of Plastics
- c) ASTM D-2671 : Heat-Shrinkable Tubing for Electrical Use
- d) ASTM E-96 : Standard Test Methods for Gravimetric Determination of Water Vapour Transmission Rate of Materials
- e) ISO 8501-1 : Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
- f) ISO 21809-3 : Petroleum and natural gas industries – External coatings of buried or submerged pipeline used in transportation system- Part -3 Field Joint Coatings
- g) SSPC-SP 1 : Solvent Cleaning, Steel Structure Painting Council


In case of conflict between the requirements of this specification and that of above referred documents, the requirements of this specification shall govern.

3.0 MATERIALS AND EQUIPMENT

3.1 General

3.1.1 Contractor shall supply all required field joint coating materials unless specified otherwise in the Contract, equipment and manpower required for a skilful and adequate application of coating in the field in accordance with this specification.

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3.1.2 Contractor shall submit and demonstrate to Company, the proposed materials and work procedures for application of field joint coating. Proposed procedures and all materials, equipment and tools used in the work shall be subject to Company's approval.

3.1.3 Contractor shall submit all details including properties and manufacturer certificates for the proposed joint corrosion coating material and in-fill material for Company's approval.

3.2 Field Joint Corrosion Coating Material

3.2.1 Field joint corrosion coating materials shall be suitable for design temperature and temperature anticipated at the field joints during normal lay-barge operations. The field joint corrosion coating material shall be heat shrinkable wraparound sleeve having a generic description as stated herein after.

3.2.1.1 Heat Shrinkable Wraparound Sleeve


The Heat Shrinkable Wraparound Sleeve shall be of Type 14A-3 as per latest edition of ISO 21809-3. Heat Shrinkable Wraparound Sleeve shall consist of an external backing made of extruded and cross-linked polyolefin. The inner surface of the sleeve shall be coated with a uniform thickness of high shear strength thermoplastic hot melt adhesive. The shrinkage of the backing instils a level of circumferential compression in the coating that supplements the bonding of the sleeve to the pipe surface. The joint coating system may consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application. The backing shall either be coated with thermo-chrome paint which will change colour when the desired heat during shrinking is attained or as recommended by the Manufacturer. Properties of the heat shrinkable wraparound sleeve shall meet the requirements of Clause 3.2.2 of this specification. Heat shrinkable wraparound sleeve shall be supplied in pre-cut sizes complying the requirements of this specification, to enable easy application during laying operations.

3.2.2 Properties of joint corrosion coating material

Properties of the backing and the as-applied joint corrosion coating shall be as follows:

3.2.2.1 Properties of Backing

Sl. No.	Property	Unit	Requirement	Test Method
1	Tensile Strength @ 25°C	kg/cm ²	≥ 160	ASTM D-638
2	Ultimate Elongation @ 25°C	%	≥ 250	ASTM D-638
3	Dielectric withstand with 1000 Volt/Sec.	Volts	≥ 30000	ASTM D-149
4	Water Vapour Transmission	g/24h/m ²	≤ 0.7	ASTM E-96
5	Heat Shock @ 200°C for 4 (four) hours (For Heat shrinkable flowing wraparound sleeve only)	-	No dripping, cracking, flowing	ASTM D-2671

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3.2.2.2 Properties of Coating System (As Applied)

Sl. No.	Property	Unit	Requirement	Test Method
1	Thickness	mm	2.5 mm on pipe body and 2.0 mm on weld bead	ISO 21809-3:2016 Annex B
2	Holiday detection at 5 kV/mm + 5 kV	-	No Holiday	ISO 21809-3:2016 Annex C
3	Impact resistance (holiday detection at 5 kV/mm + 5 kV) @ 23°C	J/mm	≥ 7	ISO 21809-3:2016 Annex D
4	Cathodic disbondment at 28 days @ 23°C	mm	≤ 15	ISO 21809-3:2016 Annex G
	Cathodic disbondment at 28 days @ 95°C	mm	≤ 20	
5	Peel strength to pipe surface and plant applied coating @ 23°C	N/mm	≥ 3.0	ISO 21809-3:2016 Annex H
	Peel strength to pipe surface and plant applied coating @ T _{max} °C	N/mm	≥ 0.20	
6	Lap shear strength at 10 mm/min @ 23°C	N/mm ²	≥ 5.0	ISO 21809-3:2016 Annex J
	Lap shear strength at 10 mm/min @ T _{max} °C	N/mm ²	≥ 0.10	

3.3 Joint In-Fill Coating

3.3.1 The field joint in-fill coating material shall be high density polyurethane foam meeting the requirements mentioned below:

3.3.1.1 High Density Polyurethane Foam

High Density Polyurethane Foam (HDPF) containing polymeric isocyanate and polyol blend having a dry density > 160 kg/m³, saturated density > 1025 kg/m³ and compressive strength > 25 kg/cm² at 90° deflection shall be used for the joint in fill coating.

3.4 Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch of materials supplied. Company reserves the right to have the materials tested in an independent laboratory. Contractor shall procure the field joint coating materials only after obtaining written approval from Company.


3.5 Materials shall not be older than their period of validity at the time of application. Deteriorated and decomposed materials shall be disposed of and replaced by Contractor at his own expense.

3.6 Contractor shall ensure that the coating materials supplied by him are properly packed and clearly marked with the following:

- Manufacturer's Name
- Material Description
- Batch Number
- Date of Manufacturing and date of expiry
- Specific storage and handling instructions

3.7 All materials shall be stored and handled by the Contractor in such a manner to prevent damage or deterioration, to the satisfaction of the Company.

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4.0 APPLICATION PROCEDURE

4.1 General

The field joint corrosion and in-fill coating application procedure shall be in accordance with manufacturer's instruction and the minimum requirements specified hereinafter whichever is more stringent and shall be demonstrated to and approved by the Company. Operators for coating application shall be given necessary instructions and training before start of work by the Contractor.

4.2 Surface Preparation

4.2.1 Oil and grease shall be removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Solvent cleaning procedure shall be according to SSPC-SP-1.

4.2.2 Prior to surface cleaning, the surface shall be completely dry. Surface shall be mechanically cleaned using wire brushes to remove dirt, loose particle of scale, rust and weld spatter to ST-3 finish of ISO 8501-1. Tools and the procedure used shall ensure that no burrs or sharp cuts are made on the pipe surface.

4.2.3 The ends of existing pipe protective coating shall be inspected prior to application and cleaned as necessary. Unbonded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned to ST-3 finish.

4.3 Application of Pipe wrap

4.3.1 Application of Heat shrinkable wraparound sleeves


4.3.1.1 Heat shrinkable wraparound sleeve shall be applied on the surface immediately after the surface cleaning operation. The wraparound sleeve over the joints shall overlap the yard applied coating by minimum 50 mm on both sides.

4.3.1.2 Before centring the wraparound sleeve, the bare steel surface shall be preheated with a torch moved back and forth over the surface to remove the moisture. The minimum preheat temperature shall be as recommended by the manufacturer and shall be checked by means of pyrometer or temperature crayons.

4.3.1.3 Then the wraparound sleeve shall be entirely wrapped around the pipe positioning the closure patch off to one side of the pipe in 10 or 2 o'clock position, with the edge of the undergoing layer facing upward. Overlap between the sleeve and closure patch shall be minimum 100 mm. The solvent free epoxy primer (whenever applicable) shall be applied prior to sleeve application as per manufacturer's recommendations.

4.3.1.4 A heat shrinking procedure shall be applied to shrink the sleeve in a manner such that all entrapped air is removed using gloved hands and hand rollers. The complete shrinking of the entire sleeve shall be obtained without undue heating of existing pipe coating and providing due bonding between pipes, sleeve and pipe coating. Heating shall be carried out until the thermo-chrome paint has changed its colour completely or as recommended by the Manufacturer. Resulting coating shall be free of wrinkles, cold spots and weld profile visible on the sleeve.

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4.4 Application of in-fill joint coating

4.4.1 Application of HDPF Foam

4.4.1.1 Subsequent to inspection of the field joint corrosion coating as mention in Clause 5.0 of this specification, a joint mould shall be formed for injecting the HDPF mix around the field joint, by wrapping a 0.5 mm thick sheet metal form. The metal form shall be pre-cut with 1.0 m width and length suitable for the pipe circumference. The form shall be securely strapped unto the concrete coating with minimum 2 metal straps on each side. The pre-cut window opening shall be located on top of the pipe.

4.4.1.2 Contractor shall supply all equipment necessary to ensure that the HDPF is mixed in a proper proportion and injected in such a manner to prevent void forming in the in-fill coating.

4.4.1.3 High Density Polyurethane Foam (HDPF) shall then be injected. Adequate foam shall be injected to ensure that foam is extruded from top window after filling all voids and the required density is achieved. After allowing the recommended setting time period, the metal form shall then be removed from the pipeline. During the application, due care shall be taken to ensure proper ventilation of escaping gases.

4.5 Application Procedure Qualification

Prior to commencement of regular field joint coating, Contractor shall carry out procedure qualification as mentioned below for joint corrosion coating and in-fill (HDPF) coating.


4.5.1 Field Joint Corrosion Coating

Contractor shall apply heat shrinkable sleeve following the procedure mentioned above or procedure recommended by the Manufacturer whichever is stringent, on a field joint on the lay-barge. This shall be done in the presence of Company Representative. Resulting coating shall be free of all defects as mentioned in this specification. Immediately after visual inspection and holiday detection, Contractor shall check the adhesion of the coating with the steel by peeling two strips of 25 mm x 200 mm cut perpendicular to the pipe axis and report the peel strength and the temperature of the joint at the time of peeling. Additionally, the joint shall be allowed to cool to 23°C and two similar strips shall be removed to determine the peel strength. Temperature of the joint shall be measured with portable digital thermometer. Peel strength @ 23°C shall be as specified in Clause 3.2.2 of this specification. In case of compliance, the peel strength determined earlier immediately after holiday detection shall be recorded and the value used as an acceptance criteria for the test mentioned in Clause 5.3 of this specification. Contractor shall submit the procedure so adopted to Company Representative and obtain Company's approval. Once the approval is given, the same shall be adopted for the regular joint coating operations. No change in the approved procedure shall be made. Contractor shall make available all relevant equipment and tools required for testing on the lay barge.

4.5.2 Field joint in-fill Coating

In case HDPF is proposed as in-fill coating, Contractor shall cast the HDPF on the field joint mentioned in Clause 4.5.1 above, following the procedures as recommended by the Manufacturer. Following completion of the in-fill coating, specimen of suitable size shall be obtained from the field joint and tests for dry density, saturated density and compressive strength in compliance with Clause 3.3.1.2 of this specification shall be carried out. In case of compliance of test results, Contractor shall submit the procedure so adapted to Company Representative for approval. Once

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the approval is given, the same procedure shall be adopted for the regular in-fill joint coating operations. No change in the approved procedure shall be made. Contractor shall make available all relevant equipment and tools required for testing in the lay barge.

- 4.5.3** In case of any defects and/or non-compliance of test results, the procedure adopted shall suitably be modified and retest carried out. Services of the manufacturer's representative, whenever necessary, shall be arranged by the Contractor at his own cost.

5.0 INSPECTION

5.1 Visual Inspection

Field joint corrosion coating shall be visually inspected to ensure adhesive extrusion on either ends of the sleeve, smooth external appearance free of wrinkles, dimples, air entrapment or void formation and weld profile is visible on the sleeve.

5.2 Holiday Detection

The entire surface of the corrosion coating shall then be inspected by means of a full circle holiday detector of the type approved by Company set to a DC Voltage of at least 10 KV, prior to application of in-fill joint coating. The holiday detector used shall be checked and calibrated daily with an accurate DC Voltmeter. If the holiday detector is of self-calibrating type, the calibration shall be demonstrated to Company representative at the start of every shift. The detector electrode shall be in direct contact with the surface of coating to be inspected. No holiday shall be permitted in the coating. In case of any holidays, the coating shall be removed and redone at no extra cost to Company.

- 5.3** In addition the corrosion coating shall be checked for adhesion and a proper bond at the interface between the yard coating and the joint coating as well as at the weld seam. Company reserves the right to remove and test 1 out of every 100 joint corrosion coating for this purpose. For each test sleeve, two strips of size 25 mm x 200 mm shall be cut perpendicular to the pipe axis and slowly peeled off. The peel strength so determined shall comply the peel strength established at Clause 4.5.1 of this specification. The system shall only fail in adhesive layer. No failure either adhesive to steel or adhesive to backing shall be permitted. Contractor shall keep all tools, equipment and instruments necessary to carry out testing on-board lay barge. In case of consistent test results, Company may at its discretion, relax the frequency of such. Subsequent to testing, the joint coating shall be repaired in compliance with Clause 6.0 of this specification.


5.4 In-fill joint coating

Subsequent to coating the joint with HDPF, hammering and pressing of metal form shall be done to locate any voids. In case any voids are found, Contractor shall repair the in-fill joint coating as per Clause 6.0 of this specification.

Dry density, saturated density and compressive strength of the in-fill coating material shall be checked on one out of every 100 joints during laying operations by suitably removing the test specimen from the joint. Test results shall comply the requirements mentioned at Clause 3.3.1.2 of this specification. Contractor shall keep all tools, equipment and instruments necessary to carry out testing on-board lay barge. In case of consistent test results, Company may at its discretion, relax the frequency of such testing.

- 5.5** If the above tests do not meet the minimum required properties, the cause of failure shall be determined and proper measures taken to achieve the requirements. Contractor shall modify

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techniques as necessary and further tests shall be carried out to prove adequacy of modified procedure. If necessary, the services of the manufacturer's experts shall be arranged by Contractor at his own cost.

6.0 REPAIRS


- 6.1** Inspection slots made during the Company inspection shall be repaired as per the Manufacturer's recommended repair procedures. Manufacturer's recommended repair procedure shall be furnished to Company and approval obtained prior to carrying out the repair works. All repaired joints shall be holiday tested as mentioned in Clause 5.2 of this specification. Contractor shall supply all materials required to carry out the repair works. Prior to start of the repair works, the surface shall be cleaned with mechanical brushes.
- 6.2** In case of repair of heat shrinkable wraparound sleeve, a patch of suitable size to ensure 50 mm overlap over the joint coating shall be applied. Sufficient heating shall be done to fix the patch with the joint coating so as to achieve a repair coating equivalent to the joint coating.
- 6.3** In case of HDPF in-fill coating, any voids > 50 mm shall be repaired in accordance with the Manufacturer's recommended repair procedure.

7.0 DOCUMENTATION

- 7.1** Contractor shall obtain the following documents from Manufacturer of corrosion and in-fill coating materials and submit to Company for approval.
- 7.2** Prior to procurement of coating materials, Contractor shall furnish the following for qualification of the Manufacturer and material:
- Complete descriptive technical catalogues describing the materials offered along with samples of corrosion coating materials, its properties and installation instruction as applicable specifically to the project.
 - Test certificates and results of previously conducted tests from independent inspection agency, for all properties listed in Clauses 3.2.2 and 3.3 of this specification.
 - Reference list of previous supplies of the similar material indicating the project details such as diameter, quantity, service conditions, year of supply, project name, contact person and feedback on performance.
- Once the Company's approval has been given, any change in material or Manufacturer shall be notified to Company, whose approval in writing of all changes shall be obtained before the materials are manufactured.
- 7.2.1** Prior to shipment of materials from the Manufacturer's Work, Contractor shall furnish—the following:
- Test certificates/results as per Manufacturer's Quality Control Procedure for each batch of materials.
 - Specific installation instructions with pictorial illustrations.
 - Specific storage and handling instruction.

- 7.3** All documents shall be in English Language only.


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ADDENDUM TO FUNCTIONAL SPECIFICATION FOR FIELD JOINT COATING (EXTERNAL) OF SUBMARINE PIPELINES


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Total No. of Pages	Date	Addendum to Rev. No.

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Sl. No.	Clause Reference, Page No.	Existing Provision in FS					Modified Clause of FS
1.	3.2.2.2 Properties of Coating System (As Applied)	Sl. No.	Property	Unit	Requirement	Test Method	-Deleted-
		6	Lap shear strength at 10 mm/min @ 23°C	N/mm ²	≥ 5.0	ISO 21809-	
			Lap shear strength at 10 mm/min @ Tmax°C	N/mm ²	≥ 0.10	3:2016 Annex J	

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FUNCTIONAL SPECIFICATION FOR

INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES

Revised By	Peer Reviewed By	Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
T.M.K.	R.P.	S.K.	M.S.	44	27.05.2022	2


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1.0 SCOPE

1.1 This specification covers the minimum requirements for transportation, fabrication, installation and other associated works of submarine pipelines and riser systems transporting hydrocarbons in liquid/gaseous phase and injection water.


1.2 This specification shall be read in conjunction with the requirements of all other specifications and documents included in the Contract.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

2.1 Reference has been made in this specification to the latest editions of the following Codes, Standards and specifications:

- | | | |
|-----------------------------------|---|--|
| a) DNV-1981 | : | Rules for Submarine Pipeline Systems |
| b) ASME B 31.4 | : | Liquid Petroleum Transportation Piping Systems |
| c) ASME B 31.8 | : | Gas Transmission and Distribution Piping Systems |
| d) API 1104 | : | Standard for Welding Pipeline and Related Facilities |
| e) API RP 1111 | : | Recommended Practice for Design Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines |
| f) API RP 5L1 | : | Recommended Practice for Rail-Road Transportation of Line Pipe |
| g) API RP 5LW | : | Recommended practice for transportation of Line pipe on barges and marine vessel |
| h) Title 49 CFR Part 192 Part 195 | : | Code of Federal Regulations. Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards |
| i) Title 49 CFR Part 195 Part 192 | : | Code of Federal Regulations. Transportation of Hazardous Liquids by Pipeline |
| j) ASTM B-127 | : | Specification for Nickel Copper Alloy Plate, Sheet & Strip |

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- | | | |
|--------------------|---|--|
| k) ASTM D-2000 | : | Classification System for Rubber Products in Automotive Application |
| l) AWS A5.11 | : | Specification for nickel and nickel-alloy welding electrodes for shielded metal arc welding |
| m) AWS A5.14 | : | Specification for nickel and nickel-alloy bare welding electrodes & rods |
| n) ASME Section IX | : | Qualification standard for welding, brazing and fusing procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators |
| o) DNV-ST-F101 | : | Standard for Subsea Pipeline System |
| p) ISO 8501-1 | : | Preparation of steel substrates before application of paints and related products |

2.2 In case of conflict between the requirements of this specification and that of above referred codes, Standards and specification the requirement of this specification shall govern.

3.0 GENERAL


3.1 Contractor shall furnish and maintain all necessary barges, tugs, vessels, equipment, tools and tackles, materials, consumable, labour, inspection and monitoring services for the successful fabrication, installation and other associated operations of submarine pipeline system. All materials, equipment and vessels shall be subjected to Company approval prior to their use.

3.2 Contractor shall fully familiarize himself with all aspects of the environmental information available for the area in which the work is to be carried out. Prior to the commencement of work, the Contractor shall be deemed to be fully familiar with the site condition relating to sea bed, wind, waves, tides, currents, etc.

3.3 Contractor shall also fully familiarize himself with the location and depth of all existing facilities and obstructions, including wrecks, boulders, pipelines cables, structures, etc., which may affect the pipeline installation and other associated operations.

3.4 Contractor shall consider the limiting weather, sea and current state in which the marine spreads can operate, whilst ensuring safety of the personnel, equipment, the Work and any other facilities in the working area and shall accordingly select equipment for the

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pipeline/riser installation and other associated operations to complete the Works within the schedule mentioned in the Contract.

3.5 The Contractor shall acquaint himself and comply with all the applicable laws and statutory regulations of the Government Agencies having jurisdiction over the area of Work, while carrying out the pipeline/riser installation and other associated operations. All such laws and regulations enforced from time to time shall be binding upon the Contractor.

3.6 Contractor shall take all necessary precautions to prevent damage to the existing facilities, during the installation and other associated operations. Contractor shall be responsible for any damage to the existing pipelines, its coatings and/or appurtenances, during the operations. The cost of repair or replacement of the existing facilities as a result of damage by Contractor's operations shall be borne by the Contractor.

3.7 Contractor shall provide full access to the Company Representative for monitoring of all Work areas during all phases of Work and shall also provide access to documentation related to the Work covered in the Contract.

3.8 Contractor shall provide office, communication and accommodation facilities for specified number of Company personnel on-board the pipeline installation vessel, as well as personnel transport facilities as mentioned elsewhere in the Contract.

3.9 In case any pipeline installation at shore approach is included in the work to be performed. Contractor shall provide round-the-clock transport facilities for the Company Representative between shore and the barge till the completion of the entire installation operation at the shore.


3.10 Contractor shall provide all diving services required to ascertain and confirm that the pipeline and appurtenances have been installed in accordance with the requirements of this specification.

3.11 Contractor shall carry out all works related to pipeline installation viz. trenching, back-filling, hydrostatic testing, etc. as applicable, as per relevant Company specification included in the Contract and the Company approved procedures.

4.0 ENGINEERING REQUIREMENTS

4.1 Procedures, drawings and calculations relevant to the pipeline/riser installation and other associated operations shall be prepared and submitted for Company approval, detailing all aspects of the installation operations.

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4.2 Calculations

The Contractor shall calculate the stresses induced in the pipelines due to pipe laying, riser installation, Pipe Line end Manifold (PLEM) installation and other associated operations. The maximum allowable combined stress (calculated based on Von Mises Criteria) in the pipeline during installation shall be 85% of the specified minimum yield strength of the pipe material. The Contractor shall outline the method and basis of the calculations in the documents submitted for Company approval. In case any computer programs are proposed, Contractor shall furnish in his Bid, a brief description of the analytical methods employed in the program along with the basis and theory used. Failure to submit the required information may invalidate the Bid.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Contractor shall investigate and select the lay barge positioning system taking into consideration:

- Water depth
- General installations and pipeline crossings
- Sea bottom soil conditions
- General environmental conditions
- Laying tolerances


5.2 Contractor shall be responsible for laying the lines within 2 meters on either of the side of the pipeline route shown in the Company approved drawings for a distance of up to 1000 meters from the Platform/PLEM or other sub-sea installation. The tolerance for the rest of the area shall be + 10 meters. However at shore approaches, the tolerance shall be + 0.5 meters. Company reserves the right to seek realignment of the installed pipeline in case the above limits are not complied. Realignment, if any, shall be carried out by the Contractor to comply the above limits, at no extra cost to Company.

5.3 At platform approaches where pipelines and pipeline appurtenances, etc., are existing, Contractor shall be responsible for laying the pipelines within the tolerances specified above without endangering the safety of the existing installations, taking into account the minimum possible barge clearances from the platform and constraints imposed by existing pipelines installations.

5.4 Contractor shall continuously monitor sea-state and general meteorological conditions from the weather forecasting receiving facilities throughout the pipeline/riser installation and associated operations.

5.5 Diver operations for crossing, unsupported spans, riser inspection and other underwater operations shall be monitored by close circuit television/monitor and underwater camera. Contractor shall make video recording of completed underwater work and permit

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Company Representative for TV/monitor viewing to enable monitoring of underwater works. Videos of such recording shall be submitted to the Company for record purposes. Contractor shall carry out all works related to pipeline/riser installation and other associated operations, strictly in accordance with the requirements of this specification and the Company approved drawings and documents, without damaging the existing pipeline installations.

5.6 Contractor shall not commence any work on installation of pipelines and associated facilities prior to the approval of the method/procedures by Company.

6.0 HANDLING, HAULING, STORAGE AND TRANSPORTATION

6.1 Contractor shall receive and take over against requisition all Company supplied materials from Company's designated place(s) of delivery as defined in the Contract. The Contractor shall be totally responsible for all materials until the acceptances of the work by the Company.


6.2 In case Company supplied materials, Representatives of the Contractor and the Company shall jointly inspect all bare/coated pipes and other associated materials at the time of handing over. Contractor shall perform visual inspection and defects, if any noted, shall be recorded separately in the presence of Company Representative. The Contractor shall be entitled to extra compensation for repair and rectification of such defects in accordance with the procedures previously approved by the Company at the rates set forth in the Contract.

6.3 Damage to pipes which occur after the Contractor has taken delivery of Company supplied pipes such as dents, flats or damage to weld ends shall be cut off or removed and pipes re-bevelled and repaired again as necessary the cost of this work, as well as that of the pipe lost in cutting and repair in excess of the wastage allowance shall be to the Contractor's account. All such works shall be carried out after written approval of the Company Representative.

6.4 Contractor shall unload, load, stockpile and transport the bare and/or concrete coated pipes using suitable means and in a manner to avoid damages to pipe body and bevelled ends and coating from designated place(s) of delivery to the work site(s). Contractor shall submit to Company for approval a detailed procedure/transportation scheme including necessary drawings of cargo barges for handling, hauling, storage and transportation prior to commencement of any handling operations. In general, pipes shall be transported in accordance with API RP 5L1 and API RP 5LW.

Contractor shall carry out a dynamic transportation analysis based on 1-year storm conditions mentioned elsewhere in the Contract, considering the proposed marine transportation scheme i.e. cargo barges and the securing arrangement and establish that the proposed transportation arrangement is safe and stable. The result of such analysis shall be submitted to Company for approval, prior to undertaking the transportation of line pipe to the work site(s).

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6.5 Adequate strapping and padding shall be provided during handling. All pipe handling equipment shall be approved by Company prior to their use. All lifting equipment shall be of such a design so as to prevent damages to the line pipe or coating. Pipes shall not be allowed to bump against any other pipe or other objects. Rolling, skidding or dragging of pipes shall not be permitted. The pipe ends during handling and stacking shall be always protected with level bevel protections.

6.6 Coated line pipes shall be handled at all times with wide non-abrasive slings and belts or end hooks. End hooks shall have sufficient width and depth to fit the inside of the pipe and shall be padded with soft material like rubber, Teflon or equivalent so as not to cause damages to bevel or pipe ends.

6.7 Stacking of coated pipes shall be carried out in such a manner to prevent concrete coating from being damaged. Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes own weight does not cause damage to concrete coating. Contractor shall calculate based on the characteristics of the concrete used, the number of layers for stacking and submit the same to Company for approval.

6.8 Truck, train and barge bolsters shall be at least 300 mm wide and well padded. When pipe is laid directly unto barge deck or the flat surfaces, these surfaces shall be clear of projecting bolt heads, uneven areas or loose hard substances such as rocks that could damage the pipe or coating. Suitable protections shall be provided in case of bold head projection.

6.9 Stacks shall be suitably secured against falling and shall consist of pipe sections having the same diameter and wall thickness.

6.10 If the Company Representative observes coating or pipe damage due to handling, Contractor shall review the handling procedure adopted and take corrective actions as required to the satisfaction of the Company Representative. Damaged pipes shall not be loaded until the repairs are done.

6.11 Contractor shall be responsible for the load out, sea fastening and transportation to site of all materials necessary for installation and satisfactory completion of all pipeline installations.


6.12 Contractor shall be solely responsible for scheduling the delivery, handling and hauling of appropriate materials to various intermediate and final locations as required by the activities enumerated in the Scope of Work forming part of the contract. Delays or lost time as a result of the Contractor's inability to schedule deliveries in time shall be to Contractor's account.

7.0 PIPELINE INSTALLATION

7.1 Survey Requirements

7.1.1 Any information available with the Company regarding bathymetry, soil and other surveys carried out by other Agencies pertaining to the Work covered in the Contract are enclosed along with the Contract Document. Any additional survey required to carry out and complete the works in all respects shall be conducted by the Contractor at no extra

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cost to Company. All surveys shall comply the requirements stated in the relevant Company survey specifications included in the Contract, as and to the extent applicable.

7.1.2 Pre-engineering survey

Pre –engineering survey of the pipeline route/corridor, shore approach as well as the platform departure/approach shall be carried out by the Contractor, in case the same is required to be performed by the Contractor as per the Contract.

7.1.3 Pre-construction Survey

Contractor shall carry out, in the laying season, a pre-construction route survey to verify any omission and discrepancies relevant to the scope of work and to ascertain the changes if any from the pre-engineering to pre- installation period as well as collect data relevant to installation, if required. During pre-construction, the as laid position of any existing stub-ends and their extremities shall be identified and recorded.

7.1.4 Post-construction Survey/As-built Survey

Contractor shall carry out a survey of the installed pipeline system utilizing equipment viz. sub-bottom profiler, side scan sonar, echo-sounder, etc. to assess the extent of unsupported spans, damage to pipelines, depth of burial riser installation etc., and to collect the information for as-built documents. Details of all remedial works such as repair to pipeline system, rectification of pipeline alignment, supports to free spans, etc. shall also be recorded subsequent to the remedial works.

7.2 Barge Navigation/Offshore Positioning System

For all works and activities related to the installation of pipelines/risers, the Contractor shall install a high resolution navigation system/radio positioning system with ± 2 meters accuracy, which shall be effective even during adverse visibility conditions and at night. Contractor shall have sufficient spare parts on-board to ensure a 24 hours a day positioning.


Contractor shall prepare and submit a survey positioning procedure including details of the barge navigation/positioning system with equipment and calibration procedures, station descriptions, etc. for Company review and approval.

7.3 Anchor Handling Requirements

7.3.1 Contractor shall follow the ‘anchor handling procedure’ mentioned at clause no.10.6.1 of Part-II, General conditions of contract of Vol.1 of the bid.

7.3.2 Prior to start of the installation works, Contractor shall submit to Company for approval, an Anchor Handling Procedure including details of barge anchors, anchor lines, winches, anchor handling tugs and position control equipment; anchor tug positioning; anchor location, anchor dropping and testing for working tension; Anchor relocation procedure Precautionary and safety measures when installing anchors in the vicinity of the existing

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installations, anchor patterns proposed along the pipeline route, and near the platform location and/or other existing installations locations shall also be submitted for Company approval. In addition, Contractor shall also indicate the anchor cable configuration (catenary) for various water depths encountered along the pipeline route with the range of tension applicable for pipeline installation, to clearly establish that the minimum clearance requirements from the existing installations as mentioned in this specification are completed.

7.3.3 Anchors shall always be positioned at such a distance from the barge to ensure that, even with the maximum working tension, there shall never be any uplift force on the anchor.

7.3.4 Anchor position and time of relocation shall be regularly logged on-board the lay barge. Constant watch shall be kept on the anchors to detect any signs of slippage/dragging.

7.3.5 Radio positioning system shall be installed on-board the anchor handling tug to enable careful monitoring of the position of each anchor, before dropping, in respect of the actual position of the existing installations.

7.3.6 In the event that an anchor/buoy is lost, the Company Representative on-board shall be immediately informed and the retrieval of the anchor/buoy shall then be arranged by the Contractor at the earliest and any delay on this account shall be to Contractor's account.

7.3.7 Anchoring near existing pipelines

7.3.7.1 While anchoring in the vicinity of the existing pipelines or installations, to safe-guard the installation from damage, special safety precautions shall be taken in respect of anchor handling and anchor positioning. The clearance between anchor and the existing pipeline /other subsea assets shall be as per xvi of clause no.10.6.1 of Part-II, General conditions of contract of Vol.1 of the bid.

7.3.7.2 Clearance between the anchor wires and the existing pipelines/pipeline appurtenances/cables:


While performing the anchor handling manoeuvres, the anchor wire shall not come in contact with any existing pipeline appurtenance/cable. The minimum vertical clearance between the wires and the pipelines/pipeline appurtenance/cable shall be 10 m. In case such clearance is not possible or impractical to achieve due to specific working conditions, then alternative arrangements viz., attachment of buoys with the anchoring wires at the crossing location, etc. shall be carried out.

7.3.8 In case of pipe laying in the vicinity of shipping channel, the anchor pennant buoys shall be clearly visible (lighted at night) and the anchoring tugs shall maintain patrol around the lay spread to warn away any vessels in the vicinity.

7.4 Field repairs to the damaged coating (Anti-corrosion and Concrete)

7.4.1 Field repairs to damaged anti-corrosion and concrete coatings shall be accomplished with

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materials and methods, which are compatible with the parent coating and provide a holiday free coating which are acceptable to the Company Representative.

7.42 If the concrete weight coating is damaged to the extent that it has become loose from the pipeline and is subject to spalling, it shall be repaired in accordance with the requirements of the ONGC FS No. 2013.

7.43 If both concrete weight coating and anti-corrosion coating are damaged, the Contractor shall remove all weight coating material within 75 mm in all directions of the defects. This removal shall leave a hole, tapering to the outside on a slope of around two parts vertical to one part horizontal. Contractor shall then remove all anti-corrosion coating within 50 mm of the defect. The defective area shall be wire brushed. Immediately following this, a primer compatible to that originally used with the anti-corrosion coating as mentioned in the ONGC FS No. 2012A shall be applied. The remainder of the path shall be with Special Mastic Mix. /HDPF of quality approved by Company.

7.5 Line-up and Welding

7.5.1 Care of Pipe

Contractor shall inspect the internal surface of each joint of pipe to ensure that the pipe is free of visual defects/damage/cracks, pitting, dirt, rust and other foreign substances. Contractor shall thoroughly clean the inside of each joint of pipe, prior to aligning the pipe for welding into the pipeline. Contractor shall advise the Company immediately, should excessive corrosion or scaling be found inside any line pipe.

7.5.2 Pipe defects and repairs

It is Contractor's responsibility to repair all internal and/or external defects. Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with the applicable Company material specifications included in the Contract.


Repair on line pipe shall be executed as specified in Company material specifications or ANSI B 31.8/ANSI B31.4/DNV whichever is more stringent. A record to all repairs is to be maintained by Contractor. This record provided with the pipe identification number shall be submitted to Company.

Dents, which contain a stress concentration such as scratch, gauge, arc burns or groove and dents located at the longitudinal weld shall be removed by cutting out the damaged portion of pipe as a cylinder.

Repair of damaged pipe ends by hammering is not allowed.

If due to cutting or repairs, the pipe identification number is removed, it shall be repainted immediately by the Contractor in the presence of Company Representative. In

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the event of line pipe supply by Company, Contractor shall be charged for any pipe length due to loss of identification number. No pipe without identification number shall be transported and/or welded into the pipeline.

7.5.3 Cleaning of pipe ends

Immediately prior to aligning pipe for welding, the bevelled ends of each joint of pipe and the area immediately adjacent thereto (at least 25 mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign matter by use of power driven wire brushes, or by other methods approved by Company.

7.5.4 Pipe Bevelling

All damaged ends of pipe that are bent, cut or otherwise mutilated such that in the opinion of the Company, faulty alignment or unacceptable welding would result, shall be repaired or cut off and re-bevelled to the correct angle with a bevelling machine of a type approved by Company. No compensation shall be allowed for reason of such re-cutting or bevelling, except when required because of the original bevel being damaged before the pipe is taken over by Contractor.

In case of line pipe supply by Company, the line pipes with bevels as mentioned in the relevant Company material specifications will be supplied to the Contractor. Re-bevelling, if required, to suit the Contractor's proposed welding procedure, shall be carried out by the Contractor at no extra cost to Company. Prior to re-bevelling, if required, the Contractor shall prepare a sketch indicating the extent of wastage of line pipe envisaged for each end, and submit the same for Company approval. Wastages beyond the extent approved by the Company shall be charged to the Contractor at the rates finalized by the Company.

7.5.5 Alignment of Pipe

7.5.5.1 All pipe joints 8" NB and above shall be aligned with an internal pneumatic line-up clamp approved by Company, except for tie-in welds or other exceptional conditions acceptable to the Company, on which occasions an external line-up clamp may be used.


7.5.5.2 All joints shall be aligned and welded with a uniform spacing. Hammers, if used, shall have bronze coated or other suitable head and shall be used in a manner as to avoid damage to the pipe.

7.5.5.3 When joining pipe containing longitudinal weld seam, the longitudinal weld seam shall be in the upper quadrants of the pipe circumference. In addition, the longitudinal welds seams shall be offset at least 20 degrees from each other.

7.5.6 Welding

Pipeline welding, welding procedure and welder qualification, non-destructive inspection and repair shall be carried out in accordance with the requirements of Company Welding

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Specification for Submarine Pipelines, included in the Contract.

7.6 Anode Spacing

Pipe joints with anodes shall be installed according to the spacing indicated in the Company approved drawings. Cares shall be taken so that the anodes, concrete and field joint coatings are not damaged while going through the stinger or over the rollers/supports.

Special care shall be taken by the Contractor to ensure that the electrical bond from the anode bracelets to the pipe is not damaged during the handling and installation of the pipes. For this purpose, the anti-corrosion applied between the concrete coating and the anodes shall be checked for any damages. In case of any visible damage to the anti-corrosion coating, Contractor shall carry out the necessary remedial works without any extra cost to Company.

7.7 Field Joint Coating

7.7.1 Field joint shall be provided with corrosion protection coating using heat shrinkable wraparound sleeve in accordance with the requirements of ONGC's FS No. 2014, included in the Contract Document.

7.7.2 In addition to the corrosion protection coating, the field joints shall be applied with in-fill coating using either mastic or polyurethane foam in accordance with the requirements of Specification No. 2014, included in the Contract Document.

7.8 Pipe Laying Operations


7.8.1 Company will obtain all necessary right of way easements from various Agencies having jurisdiction thereof. Contractor shall secure the necessary work permits for carrying out the works. Contractor shall adhere to said right of way and no changes in alignment shall be made by Contractor without prior written approval of Company. Company will advise the Contractor the right of way and permit provisions or conditions, and Contractor shall comply same and hold Company harmless of all claims, damages resulting from Contractor's failures to observe such provisions or conditions. Damage resulting from Contractor's negligence or failure to follow the designated routes shall be Contractor's sole responsibility.

7.8.2 Pipeline and appurtenances shall be installed along the route and at locations indicated in the Company approved drawings. Placement accuracy shall be as mentioned in Section 5.0 of this specification.

7.8.3 Pipeline Installation Procedure Document

Contractor shall prepare and submit to Company for approval a Pipeline Installation

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Procedure Document, which shall include, as a minimum, the following:

- a) Pipe laying equipment description including plan and profile of lay barge, ramp orientation, pipe roller arrangement/location, line- up/welding repair/field joint coating station location, tensioner location and capacity, barge positioning systems and communication facilities: details of the pipeline to be handled.
- b) Stinger description including dimension, cross section, length and roller arrangement/location.
- c) Pipe handling procedures including transportation, storage and pipe preparation.
- d) Welding, NDT, repair procedures
- e) Field joint coating procedure
- f) Pipe laying procedure including positioning control and start-up procedures.
- g) General laying procedure including positioning control and start-up procedures.
- h) Pipeline installation stress analysis including calculation of the stinger length, stinger angle or curvature and pipe tension required to restrict pipe stress levels within the allowable limits.
- i) Distance from the touch down point to the stern of the barge as well as the length of the pipe from the touch down point to the stern as a function of the tension and stinger angle in a graphical format, for all water depths encountered.
- j) Pipeline tension/configuration/stress monitoring and control details.
- k) General arrangements drawing of the buckle detector to be used.
- l) Umbilical installation procedure (if applicable) including the proposed umbilical route and the hook-up procedure to be adopted for connection with the valve actuator.
- m) Environmental conditions viz. maximum wave heights, wave period and current in which the laying can continue without damaging the pipeline.
- n) Proposed spacing between the existing and the installed pipeline and methods of maintaining the same.

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Contractor shall install instrumentation including depth gauges on the pipe lay stinger to continuously monitor the stinger configuration in order that the bending of the pipe is within the limits established in the installation stress analysis document.

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A buckle detector, as required by DNV Rules for Submarine Pipeline Systems 1981, shall be passed through the pipeline. Buckle detector is not required for 6" and below size pipelines, however Contractor to comply with the additional requirement mentioned in CI 10.6.7.2 of DNV-ST-F101. The detector shall consist of a gauging plate positioned after the touch down point. If any buckle is detected it shall be repaired before continuing pipe laying operations. Aluminium gauging plate shall be used as a buckle detector. However, use of buckle detector and Aluminium gauging plate is not required for internally coated pipelines as they may damage the internal coating.

785 Contractor shall monitor continuously the tension exerted on the pipeline during all pipe laying operations, including abandonment and recovery by providing suitable instrumentation and ensure that the tension established in the stress analysis documents approved by the Company is achieved. Excessive tension shall not be applied. A daily record of tension and other parameters specified herein affecting pipeline stresses, recorded at regular intervals and during abnormal fluctuations or abandonment/recovery, shall be submitted to Company along with corresponding computed over bend and sag bend stresses.

786 Pipe Stress Control

Stress in the pipeline shall be controlled during all phases of installation Contractor shall prepare and implement adequate procedures to control stress level in the pipe during laying such that the maximum permissible stress levels are not exceeded.

To limit bending in the over bend, the pipe support rollers on the barge and stinger or ramp must be accurately set at predetermined elevations such that support reactions and pipe bending loads are equally distributed. Contractor shall submit calculations of these positions and loads to Company as well as the proposed procedures for physical verification of these parameters during the laying operations.


Calculations and procedures shall account for the anticipated stinger deflection during laying operation due to environmental conditions, where appropriate. In case of a fixed ramp, Contractor shall indicate the proposed method for ensuring the pipe bending and pipe stresses are within the permissible limits.

787 Pipe Configuration Control

To ensure proper placement of the pipeline within the given alignment and control of the pipe curvature with acceptable limits, Contractor shall monitor the configuration of the suspended pipeline. Contractor shall submit a description of the means to monitor pipeline configuration and procedure for its use to Company prior to commencement of the installation works.

This shall consist of graphs and tables prepared specially for this work. In any event, the following items shall be included;

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a) Effect of pipe tension and tension variation on the pipe configuration as well as on pipe stresses.

b) Effects of the most critical current and wave on the suspended pipeline.

Care shall be taken, to prevent the pipeline from jumping out the stinger during the laying operations.

Contractor shall propose a procedure to verify the actual dimensional configuration of the suspended pipe and location of the touch down point at regular intervals. The procedure shall also cover regular inspection of equipment such a tensioner and singer/ramp and indicate contingency plans in case of equipment failure. It is required that Contractor provide qualified engineering personnel on the lay vessel to conduct the aforesaid tasks, to interpret the results of calculations and measurements and to advise the vessel operating crew. All results of measurements and recordings shall be made available to Company.

788 Contractor shall provide suitable pulling/lowering head for the installation of the pipelines with stub ends. The lowering head shall be designed in such a way that the stub line can be dewatered and the stub end lifted at a future date by other Contractor while installing the remaining pipeline.

The lowering head shall include the following facilities as a minimum:

- a) Check plates for pulling
- b) Pig stopper and pig indicator
- c) Ball valves and pipe fittings with blind flange for vent and drawing
- d) Barrel/pipe of sufficient length for holding the pig.


789 Joint numbers, 150 mm high, are required on every joint laid. The numbers shall be painted on the upper quarter of the pipe so that divers can easily find each joint. Records shall be kept of the joint number with the corresponding pipe mill number, and the date when the joints has been welded and laid.

7810 Contractor shall maintain a record of the joint number and length of each joint as it is welded into the line. Contractor shall maintain a record of all of all cut-outs, joint ends cut off or pipe joints added and the amended length of the joint.

7811 Contractor shall comply with the tangent points of curves and the permissible bend radii mentioned in various Company approved drawings/documents.

7812 **Piggy back lines installation**

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Where piggy back lines or umbilicals are to be located on the pipelines for installation as a bundle, then the piggy back lines/umbilicals shall be located at the top centre of the mainline. Piggy back lines shall be strapped to the mainline by means of Monel straps every 4 m all throughout the length of the line. Suitable spacers/guide supports shall be provided at every 2 m. between the strap and the line as well as between the spacer and the line, a strip of 6 mm thick neoprene shall be provided to avoid any damage to the corrosion coating. Care shall be exercised to ensure the piggy back line/umbilical does not foul with the pipeline anodes.

7&13 Stub End Pipelines

In case the Contractor is required to tie-in to any existing stub-line, Contractor shall deploy divers and shall check the condition of the lay down heads and disconnect any shackles, slings, etc. Depending on the condition of the pipeline from pre-construction survey, a survey may be carried out by a ROV for 500 m length of the stub-ends, measured from the lay-down heads to identify any obstruction, which may hamper the recovery operations.

Contractor shall carry out hydro test for a minimum period of six hours, unless otherwise specified and dewater the stub line prior to start of any lifting operations for tie-in. Contractor shall prepare and submit a procedure regarding the recovery of the stub end, including the details of hydro test and dewatering of test water, etc. for Company approval.

7&14 Emergency Flooding


In case required by the Contractor's design/procedure, whenever the pipe laying work is to be suspended due to weather conditions, the Contractor shall flood the pipeline with sea-water as per the Company approved procedures to stabilize the pipeline, provided stability calculations require flooding of the pipelines. The sea water used for flooding shall be filtered through a mechanical filter with a screen of size 50 mesh and treated with Company approved dosage of bactericide. During flooding operations, the Contractor shall monitor the water flow and pressure to ensure that it is within the safe limits established in the procedure previously approved by the Company.

Upon cessation of the conditions, and on obtaining the Company's approval the pipeline shall be emptied by the Contractor before commencement of any operations.

7&15 Any damage to the pipe weight coating during lifting, lowering, relocating or other installation operations shall be repaired by the Contractor at no extra cost to Company.

7&16 Contractor shall provide diver or other subsea inspection during the course of pipe laying operations to ensure that the suspended pipeline is within the limits of the calculated pipeline profile, the line is properly supported by the stinger, the line laid on the sea bottom is neither deformed in shape nor is the pipe coating damaged, and that the

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pipeline at the specified depth is continuously supported within the permissible limits indicated in the Company approved drawings/documents. Diver observation or other subsea inspection will also be required during pick-up and lay down of pipeline.

7.9 Pipeline Installation at Platform Approaches

7.9.1 Platform approaches are considered to be within 500 m from the existing Platform/Platform Complex. Pipelines shall be laid in this zone as straight as possible within the tolerances specified without endangering the safety of the existing pipelines and appurtenances, taking into account the minimum possible barge clearances from the platform and constraints imposed by existing pipelines/installations. Diver controlled or ROV controlled operations shall be used if necessary, in congested areas to prevent laying over the existing lines/installations.

7.9.2 Depending upon the location of the existing lines, approach angles of the pipelines to be laid, location of the riser to be installed, etc., Contractor shall decide the method of pipe laying in the Platform approaches i.e. either by initiating the pipe laying from the Platform end or by approaching the Platform from other end, lay down and side walking, unless specified otherwise. The proposed method shall be indicated in the Bid.

7.9.3 If the pipelines to be installed in platform approaches are located in platform extremities where the pipeline installation near the platform, lifting and side walking the pipeline will not result in either damaging or endangering the safety of the existing installations, Contractor may adopt the lifting and side walking procedure after obtaining written approval from the Company. In case the pipelines to be installed are located at locations other than the platform extremities and Contractor proposes to install the pipeline by lifting and side walking procedure, Contractor shall propose suitable measures to establish that the proposed method does not damage/endanger the safety of the existing installations.


7.9.4 In case pipe laying at Platform approaches initiate from the Platform end, it shall be done by making up the pipeline on board the lay barge and pulling to the sea bed. Tie-in back the snatch block to a jacket leg at the sea bed level or installing a Dead Man Anchor (DMA) shall be considered for this purpose.

7.9.5 Diver survey shall be done near the platform to clearly identify the existing pipelines and the approaches for the new lines before and after completion of the pipeline installation.

7.9.6 Contractor shall prepare and submit a Platform approach pipeline initiation procedure to Company including the following as a minimum:

- a) Method of pipeline installation at platform approaches along with schematic arrangement drawings including the details of the pipeline termination and abandonment, minimum possible barge clearances from the platform, lifting and side walking procedures, clearances from the existing installations, pipelines and

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appurtenances, if any.

- b) Calculations for the pipeline stress during abandonment. Lifting and side walking.
- c) Anchor pattern during pipeline laying at Platform approaches.
- d) Diver inspection and survey of the Platform approaches prior to laying operations.
- e) In case of pipeline initiation at Platform approaches, the following shall be furnished by the Contractor;
 - i) Calculation of the pulling load, stinger geometry and design of pulling head.
 - ii) Laying/start-up procedure including deployment of DMA/snatch block, Minimum length of pipe to be laid on the sea-bed prior to disconnection of hold back cable.
 - iii) Pipeline initiation schematic arrangement drawings with jacket tie-back system or with DMA arrangement including relative opposition of the barge, location of barge anchors.
 - iv) Details of equipment used including initiation head, pigs, sheave/snatch blocks, DMA, hold back cable etc.
 - v) Verification of loads to be experienced on the jacket during pipe lay initiation.
 - vi) Verification of holding capacity of DMA in the vicinity of the Jacket location (if applicable).

7.9.7 Installation of Expansion Loops


In case any expansion loops are required to be installed as per the Company approved drawings/documents, the Contractor shall install the same without any extra cost to Company. Contractor shall prepare a detailed installation procedure including all pertinent details of expansion loops installation and shall submit to Company for approval. Care shall be taken not to over stress the bend/loop during the installation. For this purpose necessary tie- bars/bracings shall be provided by the Contractor. Contractor shall also carry out a stress analysis considering the supporting arrangements to be adopted at the time of installation and submit the same to Company for approval.

The pipes and bends forming a part of the expansion loop shall be provided with concrete coating as per the requirements of the Company approved drawings/documents.

7.10 Pipeline Installation at Shore Approaches

- 7.10.1** Pipeline installation at shore approaches shall be carried out either by pulling inshore through shore based winches or by fabricating the strings at the shore and pulling offshore through the barge winches depending upon the availability of the equipment and the availability of space at shore location unless specified otherwise. Contractor shall

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decide the method of installation at shore approaches in consultation with the Company.

7.102 Pipeline shall be welded, radiographed, field joint coated as per the requirements mentioned elsewhere in the specification and the pipeline installation shall be carried out as per the Company approved procedures.

7.103 Contractor shall prepare a detailed procedure, including all relevant calculations, drawings and sequence of operations to demonstrate the feasibility of the proposed methods for pipe laying methods for pipe laying at the shore approaches. Shore approach installation procedures shall be submitted to the Company for approval. The procedure shall include as a minimum the following:

- a) Details of the proposed shore approach pipe laying spread including the marine and the land based equipment.
- b) Plan, procedure and schedule for the pulling operations including details of the location with limits where the operation is to be performed.
- c) Details of the sea bed preparation work including inspection methods and procedures.
- d) Method of pulling along with the description of pulling equipment including capacity, instrumentation; and location of pulling equipment location and details of the hold back winch.
- e) Sequence of operations of pulling including the installation of cables, attachment of cable with the pull head, etc.
- f) Length of pulling considered during the high/low water levels.
- g) Number of pull cables/ropes and capacity of sheaves proposed to be used.
- h) Estimated pulling force calculation including pipe/soil as well as cable soil friction coefficients; and selection of pulling winches/cables including factor of safety considered in selection of the pulling winches/cable as well as the reserve pulling capacity.
- i) Method of anchoring the winch along with winch anchor block calculations; Method of anchoring the barge.
- j) Calculation for designing of pulls head and verification procedure for the conditions expected during the pulling operations.
- k) Details of buoyancy tanks proposed to be provided along with the method of strapping with the pipe and the reserve capacity of the buoyancy tanks.

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- l) Details of string make-up yard, launch way, rollers, etc. required.
- m) Details of safety measures to be adopted during pulling operations.
- n) Method, procedure, equipment and instrumentation of how the pulling operations will be monitored, and the stress limits of the pipelines are kept within established limits.
- o) Communication facilities proposed during the pulling between the shore and the barge.
- p) Contingency procedure to be adopted during pulling.
- q) Logistics of pulling and associated equipment installation.
- r) General arrangement drawings of the pulling plant.
- s) Pipeline profile/configuration for estimating the pulling force along with the proposed trench profile.
- t) Winch and other instrumentation calibration certificates not older than 3 months.


7.104 Lateral forces on the pipeline due to current during pulling and increase in pull load due to sea bed slope at the shore approach shall be taken into account by the Contractor, while estimating the pulling force. Unless otherwise specified, the Contractor shall consider pipe-to-soil friction factor as 1.0 for estimating the pull force. All equipment including the winch, cable, sheaves, etc. used in the pulling operations shall have a factor of safety of minimum 1.5 to take care of the variations in the assumptions. Pulling equipment not meeting the above requirements shall not be used in the pulling operations. Company approval shall be obtained by the Contractor prior to mobilizing the pulling equipment. For this purpose the inspection certificates as well as the calibration certificates of the winch issued by the independent Inspection Agency shall be submitted to Company.

7.105 In case of any soil borehole data is available at the shore approach/beach location, the same shall be used for winch foundation calculation. In case no soil data is available, the Contractor shall carry out a soil investigation/bore hole to assess the properties of soil, for use in the winch foundation calculations.

7.106 Buoyancy tanks may be strapped to the pipeline while pulling, to reduce the pulling load. In case buoyancy tanks are proposed, the pipeline shall be checked for stability under 1-Year storm conditions. Lightening of the pipeline beyond the 1-Year storm stability requirements is not permitted.

7.107 Steel bands of 30 mm width shall be used for strapping the buoyancy tanks with the pipeline. Each buoyancy tanks shall be strapped with the pipeline with minimum of three such bands. In order to avoid damages to bands and subsequent release of buoyancy tanks


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while pulling the pipelines, the bottom quadrant of the pipeline shall not be wrapped with the bands. Bands shall be secured with the pipeline using Crawl plugs or other suitable means. Each buoyancy tank shall be provided with a rope hook at both ends, so that they can be connected with the adjacent tanks during pulling operations.

- 7.10.8** In case circular steel drums are used as buoyancy tanks, wedges shall be provided between the tanks and the pipeline, in order prevent sliding of the tanks due to environmental actions during pulling. In case of polyurethane moulded floats are used, the bottom quarter shall be provided with a circular contour matching that of the diameter of the pipe to be pulled.
- 7.10.9** Pulling head shall be suitable provided with buoyancy tanks during the pulling operations, so that the pulling head does not plough into the soil and lifting slightly off the sea bed during the pulling. Also in case the stinger is used during the pulling operations, it may not be possible to pull the pulling head along the stinger and therefore it may be necessary to de-ballast the stinger until the pulling head is clear and reaches sea bed before stinger is ballasted to support the pipeline.
- 7.10.10** Prior to pulling operations, the Contractor shall submit a drawing clearly indicating the area required for pulling operations to Company for approval. Once the Company approval is given, the Contractor shall restrict himself within this area of operation only.
- 7.10.11** At the time of pulling, the Contractor shall fence/cordon off the entire work site to prevent the entry of the unauthorized personnel. Provision shall be made for the installation of no-admittance signs to unauthorized personnel. Signs indicating the “Pulling in progress – Danger – Keep away” in English and the local language shall be placed at the work site.
- 7.10.12** During the pulling operations, the barge anchor pennant buoys shall be clearly visible (lighted at night) and the anchor tugs patrol around the barge to divert/caution the approaching fishing crafts, if any in the vicinity.
- 7.10.13** Tide poles and current meters at appropriate location shall be installed and reading taken regularly by the Contractor during the pulling operations.
- 7.10.14** Contractor shall use dynamometers during pulling operations for control and recording the loads transmitted through the pulling cables. In addition the each pulling winches shall also be provided with automatic recorders to record the load vs. the length of the pull data. Dynamometers and recorders shall be suitably placed for monitoring by Company Representative during the progress of the pulling operations. In case the actual pulling load exceeds the estimated pulling load, the pulling operations shall be suspended and Contractor shall investigate the reason for increase in the load. Remedial measures shall be carried out by the Contractor to the satisfaction of the Company Representative before continuing the pulling.

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7.10.15 Contractor shall maintain a pulling log-book and record the following during the pulling operations, viz.

- Date, time (start/finish) and duration of each pull
- Length of pull
- Buoyancy provided
- Tide levels and the current readings during the pulling
- Maximum and minimum load experienced during each pull
- Rate of pulling
- Interruption in pulling, if any along with the reasons for same.

Such logs shall be submitted to Company Representative for information along with the charts of the automatic load recorders whenever requested or immediately upon completion of the pulling operations.


7.10.16 Subsequent to completion of the pulling operations, the entire area at the shore/beach shall be restored to the original conditions to the complete satisfaction of the Company Representative and other Agencies having jurisdiction thereof. Winch foundation shall be dismantled subsequent to the completion of the pulling operations, unless otherwise specified.

7.11 Pipeline Abandonment and Recovery

7.11.1 In case pipelines are to be abandoned during the pipe laying operations, either because of bad weather conditions or for any other reasons and subsequently recovered upon cessation of the conditions, the Contractor shall develop the Abandonment/recovery Procedures and submit the same for Company approval. The procedures shall be suitable for the Contractor's equipment and laying method and for the various water depths encountered along the pipeline route. The procedure shall include as a minimum the following:

- Stress analysis during the abandonment/recovery operations, for various water depths to be encountered along the pipeline route using the proposed lay barge equipment details.
- Drawings/schematic illustrations indicating the various stages of abandonment/recovery operation including the touch down point location.
- Description of the stepwise procedures and sequence of operations.

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- d) Method proposed to verify the calculation result during the execution of the operations.
- e) A/R winch capacity.
- f) Details of the lowering head as per para 7.8.9.

8.0 RISER INSTALLATION

8.1 The riser shall be installed in accordance with the Company approved procedures without damaging pipe and its coating.

8.2 The tie-in between the pipeline and the riser shall be of welded construction, unless specified otherwise.


8.3 Contractor shall prepare and submit a riser installation procedure to Company for approval. The procedure shall include, as a minimum, the following:

- a) Stress analysis of the riser during installation.
- b) Details of the equipment to be used for the riser installation.
- c) Drawings/schematic illustrations indicating the various stages of riser installation operation including pipe configuration during lifting/lowering.
- d) Descriptions of the stepwise procedures and sequence of operations for pipeline/riser tie-in and riser installation.
- e) Diving procedures and extent of diver inspection and measurements.
- f) Platform/jacket survey details to ascertain the riser/clamp locations, condition of clamps, and presence of boat landing/riser protectors. Presence of jacket anodes at riser location etc.
- g) Procedure for installation of riser clamps
- h) Any contingency procedures envisaged during riser installation.

8.4 Prior to start of the riser installation, survey of the pipe end shall be made to ensure that there are no obstructions to the lifting operations. The position of the pipeline on the sea bed shall be carefully determined.

8.5 Contractor shall carry out a survey to ascertain the riser clamp location, condition of clamps, and presence of boat landing/riser protectors. Presence of jacket anodes at riser location, etc. prior to riser installation as a part of the pre-engineering survey. The survey for these shall be carried out using sector scan, diver inspection. Contractor shall make

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video recordings of the survey and submit the same to company Other survey documents shall be submitted to Company for information and approval in case any modification is required to be carried out.

8.6 In case the jacket anodes are fouling with the clamp locations, Contractor shall consider redesigning of the clamps to avoid anode removal. If jacket anodes removal is unavoidable during riser clamp installation, then these anodes shall be reinstalled in the nearest suitable location by the Contractor without any cost and time effect to Company. Number of anodes to be removed and reinstalled shall be finalized by the Contractor after the pre- construction survey of the existing platform, and shall be submitted to Company for approval.

8.7 Anodes shall be installed to the risers as per the spacing indicated in the Company approved drawings.

8.8 Diagonal bracing shall be attached to the bottom of riser bends by clamps during fabrication. These bracings shall be removed or a two foot section cut out of the brace after riser installation is completed and clamps are tightened.

8.9 The risers shall be supported by hanger flanges and guided by non-frictional riser clamps. All bolting on the riser clamps shall utilize fully tightened double nuts on each end of the studs. Number of clamps and their location shall be as indicated in the Company approved drawings.


8.10 Clamps shall generally comply the requirements indicated in the drawings enclosed in the Contract Document. Clamps shall be internally provided with 12 mm thick neoprene padding, vulcanized to the clamps steel surface. Where adjustable clamps are provided electrical continuity for cathodic protection of the clamps shall be provided between jacket and clamps. Neoprene material requirements as well as the fabrication requirements shall comply the following requirements.

8.10.1 Material

Neoprene shall conform to ASTM D-2000, Class “BC” as per “line call out” M3 BC 725 C12 G21K11Z or equivalent and shall comply all chemical and mechanical properties requirements of ASTM D-2000. Neoprene shall have sufficient water resistance that after kept in submerged condition in sea water for a period of two weeks at 23°C, it shall retain at least 95% of all the properties mentioned in ASTM D-2000. Neoprene shall be provided with certificates for the properties mentioned in ASTM D-2000 as well as certificate for water resistance.

8.10.2 All inside surface of the clamps shall be free from pitting or any other material imperfections. The surface shall be degreased and dry abrasive blast cleaned (using metallic abrasive or garnet) to SA 2½ as per ISO 8501-1 prior to application of the neoprene sheathing.

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- 8.10.3** Compatible adhesive of Company approved quality shall be used to fix the neoprene to the steel surface, Lined clamps shall be closed using dummy pipes of appropriate diameter, bolts secured and the entire assembly put in an autoclave including the details of the material and application procedures proposed for the neoprene padding and shall obtain Company approval prior to start of vulcanizing operation. Thickness tolerance after vulcanizing shall be $\pm 5\%$.

In case Contractor proposes to affix the neoprene sheathing with the clamps using proven methods other than vulcanizing, details of the same shall be furnished to the Company along with relevant details of the past experience in similar subsea application wherein this method has been adopted and the test result of the as applied coating to establish that the proposed affixing scheme is equivalent or superior to the vulcanizing method. Upon review of such details, Company may grant approval of the proposed method. In case sufficient details of the proposed affixing method along with the necessary back-up documents are not furnished, Company will have the right to either request for additional tests or to insist for vulcanizing.

- 8.11** Risers including bends shall be coated & wrapped with anti-corrosion material and shall also be provided with a minimum thickness of 30 mm concrete coating, as per the specifications included in the Contract, from seabed up to the splash zone. The field joint between the riser and pipeline connection and on risers shall be coated as per the requirements of ONGC FS No. 2014.

- 8.12** Risers extending above the splash zone shall be painted in accordance with Company General Specification No. 2005 "Protective Coating".

- 8.13** Splash Zone portion extending from -2.0 m w.r.t chart Datum (CD) up to $+6$ m w.r.t. CD or bottom of hanger flange clamp, whichever is higher shall be applied with a 5 mm thick Monel sheathing. Monel sheet shall be welded to the riser pipe at the top and bottom to form a tight jacket which shall have facilities for future testing for tightness.


Material and fabrication requirements of Monel sheathing shall comply the requirements given below:

8.13.1 Material

Monel sheet conforming to ASTM B 127 or equivalent in annealed condition shall be used for sheathing purposes and the Monel sheathing shall comply chemical and mechanical properties requirements of ASTM B 127 as applicable. Monel shall be provided with test certificates for all properties mentioned in ASTM B 127 as applicable. Monel sheet of 5 mm thickness shall be used for the sheathing purposes.

- 8.13.2** Pipe surface where the Monel sheathing to be applied shall be sand blast cleaned to SA 2 $\frac{1}{2}$ as per ISO 8501-1. In addition, the area where the welding is to be done shall be cleaned of all contaminants and then wiped down with a clean white cloth prior to

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welding. If necessary, acetone or trichloroethylene shall be used to remove the traces of any contaminants.


- 8.13.3** Monel sheathing shall be welded with the pipe either by using Tungsten Inert Gas (TIG) welding technique or by Shielded Metal Arc Welding (SMAW) process. In case of TIG welding, the filler metal shall be Monel composition (AWS A-5.14, ER Ni Cu-7) for joining Monel to Monel, and nickel composition (ASW A-5.14, ER Ni-1) joining Monel to carbon steel, or equivalent approved by Company. In case of SMAW welding, electrodes conforming to AWS A-5.11 E Ni Cu-7 shall be used. Contractor shall carryout welding procedure qualification in accordance with ASME Section IX and DNV and submit relevant documents to Company for approval prior to carrying out any Monel welding operations.
- 8.13.4** Monel sheets shall be rolled or formed in cold condition to suit the outer diameter of the steel pipe, and fitted unto the pipe. The Monel sheet shall be fitted tightly around the pipe, with in place with a metal strapping. Tack welding on the pipe shall be done only on doubler plates positioned between the pipe and the Monel sheet. Any bulges, wrinkles, etc., in the Monel sheet shall be worked out prior to welding. The total area covered by the Monel sheathing shall be divided into two sections of approximately equal length as shown in Fig. No. 8.13.4. Each section shall have the provision for pressure testing. Monel to carbon steel welds shall be at the ends of the jacket and in the middle. All other welds shall be Monel to Monel.
- 8.13.5** After each weld run, the welds shall be cleaned by hand grinding. To prevent damage to the Monel cladding by weld spatter, the Monel surfaces adjacent to the welds are to be coated with a temporary lime wash.
- 8.13.6** All welds shall be checked over their full length by radiography. However, for fillet welds, where carrying out of radiography is not possible, dye penetration test shall be carried out on 100% of such weld joint.
- 8.13.7** Final assembly i.e. Monel to Monel and Monel to carbon steel welds shall be nitrogen and soap tested for a duration of 30 minutes at a pressure of 1.5 kg/cm² (g) to ensure leak free assembly.

9.0 PIPELINE CROSSINGS

- 9.1** Pipeline crossings shall be so installed that they will not affect or danger the safety of the existing pipeline and its operation.
- 9.2** In case of pipeline crossings, prior to pipe laying operation, Contractor shall provide a marker buoy at a point on the existing line where the proposed line will cross over it.

A general layout of the existing pipelines and the proposed crossing locations are included in the Contract Document. It shall be the Contractor's responsibility to conduct

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a detailed and accurate survey of the existing pipelines to determine their exact location and depth of the burial around the proposed crossing. The Contractor shall carry out the soil investigation as required at all pipeline crossing locations to determine the soil bearing capacity for support/grout bags.

9.3 Crossing Design

931 Contractor shall design the pipeline crossing considering various information mentioned in the Contract Document and submit to Company for approval. General arrangement of pipeline at the crossing, shall be as indicated in the relevant drawings included in the Contract. Pipeline crossings shall be designed to ensure on-bottom stability under the 100 year storm conditions. Crossing design calculations shall include as a minimum the following:

- Stress in the pipeline at crossing location
- Calculations for settlement of support/stability of support, based on soil bearing capacity established during the soil investigation
- Check for the vortex shedding
- Support/grout bag details.

932 Pipeline crossing shall be designed to ensure that the induced stresses from combined functional and environmental loading conditions comply with the requirements of DNV Rules for Submarine Pipeline Systems, 1981 for both installation and operating conditions and the requirements mentioned in this specification.

933 Approach angle of the pipeline being installed with respect to the existing line should not be less than 30°.

934 Grout, bags/separators shall be provided to maintain a physical separation of 350 mm or more between the existing line and the proposed line for the life span of the proposed pipeline. Grout bags/separators shall be of sufficient length to ensure stability to remain under the pipeline during the operational life time of the pipeline.

9.4 Installation


9.4.1 The installation of the pipeline crossing shall be executed in such a way that no shut down of the operating line is required.

9.4.2 Crossing of the pipelines shall normally be at sufficient distance from the platforms to allow installation/maintenance and/or removal of newly installed or existing pipeline/riser without disturbing the crossing installation.

9.5 Material

The grout filled support bags shall be able to withstand the marine environment, functional and operational forces of the pipeline for the life span of the pipeline. The grout bags shall be

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constructed of a woven acrylic coated nylon or equivalent material. The details and the specifications of the material to be used for the crossings, shall be submitted by the Contractor to Company for approval.

Cement for the grout shall conform to Portland cement as per API Class G or equivalent. The grout shall have a minimum compressive strength of 105 kg/cm² at 24 h and 422 kg/cm² at 28 days. The grout shall have a density of 1920 ± 60 kg/m³.

9.6 Free Spans

The free spans of the exposed pipelines at the crossings shall also be supported by grout bags. The length of the free span between the two supports shall not exceed the limits as mentioned in the Company approved documents.

9.7 Inspection

The Contractor shall perform a detailed inspection of all the pipeline crossings and submit an inspection report and preliminary as-built survey report to the Company for approval. The inspection shall be done by the Contractor's divers 12 hours after completion of the installation. This report shall also include the video recording and minimum of four good quality underwater photographs of the crossing and free span supports for each crossing. The Contractor shall submit to Company the procedure and the technique he proposes to use for such inspection for approval.


10.0 PIPELINE FREE SPANS AND SUPPORTS

10.1 Free Span Rectification

Subsequent to completion of the pipeline installation and crossing installation, a complete survey shall be made to ensure that no free span in excess of the permissible span established in the Company approved documents exists. The survey shall be conducted using a side scan sonar, echo sounder and an ROV fitted with a video camera to define each span. The results of this survey shall be submitted to Company not later than one week after completion of such survey.

10.2 Free spans in excess of acceptable spans shall then be identified in consultation with Company Representative. The free spans shall then be rectified/corrected either by providing adequate supports consisting of grout bags underneath the pipe in hard soils or by suitably jetting and lowering the supporting points, in accordance with the procedures and methods approved by the Company. The grout bags shall meet the requirements mentioned in section 9.0 of this specification. In case any unacceptable span in pipeline which are proposed to be trenched at a later date, then the Contractor shall reduce the suspended span length by suitably jetting or other means. Checks shall be made upon completion of the span correction work by hydrographic surveys and diving inspections to ensure that the pipeline spans have been reduced to allowable limits as per Company

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approved documents. Company shall be kept fully informed during all phases of the span rectification work.

10.3 Rectification of all spans greater than the maximum allowable lengths be completed to the satisfaction of the Company Representative before start of back filling works, if any and hydrostatic testing works.

10.4 Installation of supports and/or protection, using approved grout bags or protective saddles, at specified locations shall be as per the procedure prepared and submitted by the Contractor and approved by the Company.

11.0 CATHODIC PROTECTION SURVEY

Contractor shall carry out cathodic protection survey of the installed pipeline as per the relevant Company specifications included in the Contract document. Prior to carrying out the cathodic protection survey, the Contractor shall submit the relevant procedures as per the requirements of the specifications to Company for approval. Cathodic protection survey shall commence only after obtaining the Company approval.

12.0 ON-LINE VALVES, LATERALS AND PLEM INSTALALTION

12.1 General

12.1.1 All piping/pipeline fabrication required for making up the on-line valve, lateral and PLEM assemblies shall be carried out in compliance with the requirements of section 13.0 of this specification.

12.1.2 Contractor shall install the on-line valves and laterals within + 10 meters from the location shown in the Company approved drawings along the pipeline route. PLEM shall be installed as close to the lateral as possible, but within +2 m of the approved location.


12.1.3 Care shall be exercised by the Contractor during the installation to avoid damage to the pipeline, coating and appurtenances being installed.

12.2 Design

12.2.1 Contractor shall design the complete on-line, lateral PLEM assemblies including piping, supports, and structures as required along with the protective cages for the complete and effective functioning of the system, taking into account the scheme indicated in the Process and Instrumentation Diagram included in the Contract. PLEM – lateral hook-up scheme shall be designed taking into account the details of the existing facilities included in the Contract as well as the details obtained during the pre-engineering survey.

12.2.2 On-line valve, lateral and PLEM assemblies shall be designed to ensure that the induced stresses form combined functional and environmental loading conditions comply with the

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requirements on DNV Rules for Submarine Pipeline Systems, 1981 for both installation and operating conditions and the requirements mentioned in this specification. The assemblies shall be designed to withstand the 100 year storm conditions, mentioned in the Contract.

1223 The on-line valve, lateral and PLEM system shall be suitable for operation in sub-sea at the water depths and environmental conditions indicated in the Contract Document and shall be designed for a life span of not less than 25 years.

1224 All connections shall be by welding except for future tie in for which flanged end shall be provided, unless otherwise specified.

1225 On-line valve/lateral assembly shall be designed for installation on sea bed with uniform support. Contractor shall check the soil bearing capacity of the soil at the location and shall design the lateral/on-line valve assembly against any future settlement. In case no soil data is available, Contractor shall carry out soil investigation at the location of laterals/on-line valves at no extra cost to Company. Even in case the pipelines are required to be buried, lateral/on-line valve assembly shall be configured to rest on the sea bed.

1226 On-line valves including ball/check valves, laterals and PLEM assemblies shall be provided with a protective cage to protect from external damage due to falling objects. The protective cage shall be designed such that the operation of the valves are not impeded and necessary access is available for the diver intervention. Further, protective cage on the lateral (branch connection for future hook-up) shall be installed in such a way that future hook up is possible without resorting to cutting of the protective cages.

1227 Cathodic protection of the PLEM assembly supports, structures and the protective cages of the on-line valve, lateral and PLEM assemblies shall be designed as per the relevant specifications included in the Contract by suitably providing sacrificial anodes. Contractor shall submit the detailed design, material, manufacturer and reference list to Company for prior approval.


1228 PLEM Structure and Piles

PLEM support structure and piles shall be designed to resist the maximum loads imposed on the PLEM system during 100 year storm conditions and for operational load conditions.

PLEM structure shall be provided with minimum four piles and shall be designed for existing soil conditions in that location. For this purpose, Contractor shall carry out soil investigation at this location if there is no data available. It shall be designed with a minimum load factor of 2 under 100 year storm conditions.

Design of the structures and PLEM piles shall be carried out as per the relevant

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specifications enclosed in the Contract.

12.3 Materials

Materials for various components used in the fabrication of on-line valves, laterals and PLEM assemblies shall be suitable for the service and sub-sea environments indicated in the Contract and shall strictly conform to the relevant Company Material Specifications for the Submarine Pipeline included in the Contract.

12.4 Painting

On-line valves, lateral and PLEM assemblies including their protective cages shall be suitably coated with marine epoxy coating and anti-fouling paint, suitable for long term sub-sea service. A top coat of white paint shall be applied for easy detection by divers underwater. Application of coating shall be as per ONGC's "General specifications for protective coating," Specs No: 2005. Contractor shall prepare and submit details of the coating and painting scheme suitable for the prevailing conditions for Company approval.

12.5 Marking

Stainless steel plate or other materials with embossed letter and radiant paints for long term sub-sea service indicating the designation of the on-line valve/lateral/PLEM assembly shall be welded with the protective cage, so as to enable easy location and identification by divers.

12.6 Installation

12.6.1 Contractor shall prepare and submit a procedure to be adopted during the assembly installation including schematic arrangement. Procedure shall include functional testing of valves prior to installation on barge.


12.6.2 On-Line Valve/Lateral Assemblies

12.6.2.1 Contractor shall carry out a stress analysis of the pipeline during installation of lateral/on-line valves considering the loads and bending moment capabilities of the valve and shall ensure that the stress levels and the bending moment on valves are not exceeded. Floats may be attached during installation in case additional buoyancy is required in the calculations.

12.6.2.2 Ball valves, check valves and lateral assemblies shall be installed in such a way that they are as close to vertical as possible/Care shall be exercised to prevent the valves/laterals assemblies from experiencing any torsion during the installation. Suitable checks shall be carried out while the assemblies are passing through the stinger.

12.6.2.3 Shims/protection shield/wooden packing shall be provided in such a way that while

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passing through the barge stinger, the assembly does not get damaged.

12.6.3 PLEM

12.6.3.1 It shall be the responsibility of the Contractor to locate the existing lateral connections by conducting detailed and accurate underwater surveys to establish the relevant details required for the design and installation of PLEM tie-in.

12.6.3.2 Contractor shall remove any debris, fishing nets, etc. around the area of the lateral before making the PLEM hook-up. Contractor shall ensure that the internal surface of the prefabricated PLEM assemblies is clean of all loose sand, materials, weld spatter etc. prior to installation.

12.6.3.3 The pipeline to PLEM connection shall normally be welded unless otherwise indicated as flanged in the Company approved drawings.

12.6.3.4 Contractor shall check whether the existing valves on the laterals are in open or closed position. If required the valve shall be closed prior to removal of blind flange for PLEM hook-up.

12.6.3.5 The Contractor shall adopt suitable PLEM installation procedures to comply the stress limits as mentioned elsewhere in this specification.

12.6.3.6 Pile supports required shall be installed subsequent to installation of the PLEM assembly.

12.7 Contractor shall be responsible to make the valves functional, subsequent to installation of these assemblies and shall demonstrate the same to the Company Representative by suitably opening and closing the valves. For actuated valves, the opening and closing shall be demonstrated by use of portable nitrogen cylinders by divers. The demonstration shall be video recorded and submitted to the Company Representative.

12.8 For valves operated through umbilicals, Contractor shall demonstrate the valve function by operating the Hydraulic Power Unit (HPU).


12.9 Testing

After installation, these assemblies shall be hydrostatically tested along with the connected pipeline, complying the requirements of the Specification No. 2022. Prior to installation, on-line valve, lateral and PLEM assemblies shall be hydrostatically pre-tested in compliance with the requirement of clause 13.6 of this specification.

13.0 PIPING DESIGN AND FABRICATION REQUIREMENTS

13.1 All piping shall be designed, fabricated and inspected as per the Company approved procedure, documents drawings and in compliance with the applicable codes and

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standards mentioned in this specification.

13.2 Piping Design

13.2.1 All piping drawings including lay-outs and isometrics shall be prepared in compliance with the requirements of the specification and submitted to Company for approval prior to fabrication. Only after obtaining Company approval, the fabrication shall begin.

13.2.2 All design calculations for thermal expansion/flexibility etc. shall be made in accordance with the relevant code requirement and submitted to Company for approval.

13.2.3 Piping and equipment shall be adequately supported for weight of piping water full, attached unsupported components, and any other applicable forces. Care shall be taken that these supports are adequate to prevent excessive stress, loads or moments in either the piping or nozzle of the equipment to which it is connected.

13.2.4 Adequate space shall be provided in order to provide diver access to valves and equipment during regular operation and maintenance of the system.

13.3 Piping Fabrication

13.3.1 Dimensional Tolerances


Dimensional tolerances, to be adopted during the fabrication works, shall comply with the requirements stated in the referred codes and standards. These tolerances shall apply on approved drawings. Contractor shall be responsible for working to the exact dimensions as per the approved drawings. These tolerances shall apply to in-line items and connections for other lines. In addition, dimensional tolerance for finished fabricated piping shall comply the following requirements:

- General dimensional tolerance such as face to face end to end and center to center shall be ± 3 mm.
- Inclination tolerance of flange face from true alignment in any direction shall be 0.8 mm.
- Displacement tolerance of branch connection from the indicated location shall be ± 1.6 mm. When multiple branches are involved, the displacement of the branches shall not exceed 3 mm from a common point.
- Rotation of flange bolt holes shall not exceed 1.6 mm.

13.3.2 On-line valve, lateral and PLEM assemblies shall be fabricated as per the Company approved drawings. It is Contractor's responsibility to have the units completely assembled, tested and made fully functional.

13.3.3 Branch connections shall be provided in accordance with the branch connection details

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indicated in the relevant Company Material Specification for Submarine Pipeline included in the Contract.

13.3.4 Valves with flow arrows shall be installed according to the normal flow in the pipeline. During welding, the valves shall be in fully open position. In addition, Manufacturer's instructions shall be strictly adopted in entirety. Care shall be taken to avoid entry of sand particles, etc. in to the valve body, seals etc. during transportation, storage, assembly and installation.

13.3.5 All valves shall be handled using equipment and methods to avoid impact. In particular, the equipment and tools for lifting and handling shall never be done through hand wheel, valve stem, flange joints and other parts which may suffer damage and handling shall be done only through the lifting lugs provided on the valves.

13.3.6 Contractor shall ensure that the piping assemblies are not in strain or highly stressed prior to the final bolting or welding.

13.3.7 Flanged Connections

1337.1 Contractor shall ensure that all flange faces are parallel and centered according to standard practice, prior to final bolting. Contractor shall not use bolting. Contractor shall not use bolting forces as means for attaining alignment. Gasket complying the requirements of Company Material Specification for Submarine Pipelines shall be installed between the flanges at each joint. In case of subsea tie-in at existing flange joint, new gasket/ring shall be used.

1337.2 Bolts shall be tightened in diagonal sequence and shall be centered with equal amounts of thread visible on both sides. Bolts shall be uniformly tightened to produce a leak-proof joint. Bolts that yield during tightening shall be removed and discarded. It is mandatory that a torque wrench be used for bolt tightening.


1337.3 Flange bolt holes shall straddle the established horizontal and vertical center lines of the pipe, unless other orientation is required as per the Company approved drawings.

13.3.8 Welded Connections

1338.1 All welding and welding procedure qualification and NDT shall be performed in accordance with the Company specification included in the Contract. Welding procedure shall be established and qualified in the presence of the Company Representative. Documentation of the welding procedure shall be prepared and submitted by the Contractor to Company for approval prior to beginning of welding.

1338.2 All welds shall be 100% radiographically examined. However, wherever radiography is not possible, other NDT tests such as Automated Ultrasonic Test (AUT) / Manual Ultrasonic Test (MUT) / Phased Array Ultrasonic Test (PAUT) are permitted. For fillet welds, where

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carrying out of above tests is not possible, magnetic particle test or dye penetrant test shall be carried on 100% of such weld joint.

133.83 Where the ends of the piping components being welded have unequal thicknesses, the edge preparation shall be carried out as per ANSI B31.8/ANSI B 31.4 as applicable.

133.84 Back-up rings shall not be used during welding.

13.4 Inspection

All piping work shall be subjected to inspection by Company at any time during fabrication. Contractor shall furnish to Company detailed work program sufficient in advance in order to enable Company to arrange for inspection.

13.5 Cleaning

Contractor shall ensure that all equipment and piping are thoroughly swabbed clean of all dust, refuse, weld –spatter, scale or any potentially detachable matter by suitable mechanical means prior to the tie-in or final welding/bolting.

13.6 Testing

On-line valve, lateral and PLEM assemblies shall be hydrostatically tested after pre-fabrication in the yard for a minimum duration of 6 hours, with the test pressure equal to that of the pipeline hydro test pressure.

After successful completion of hydrostatic testing, the entire assembly shall be dewatered and dried using compressed air. Hydro test records shall be submitted to Company for approval.

14.0 CLEAN-UP, RESTORATION AND DISPOSAL OF SURPLUS MATERAILS


14.1 Clean-up

During pipeline installation, Contractor shall not discard any construction material, scrap or other objects at any point along the pipeline routes. Any stacks, buoys or temporary obstructions placed along the pipeline right of way in the water or on land shall be removed at Contractor's expense unless Company specifically requests that they be left in place.

14.2 Restoration

Work space furnished to the Contractor shall be cleaned of all scrap and debris and restored to such stable and usable condition as may be reasonably consistent with the

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condition of the right of way prior to laying of the pipeline. Contractor shall restore the original shoreline contours and conditions to the satisfaction of the Company and Governmental Agencies having jurisdiction over the area.

14.3 Surplus Materials

All surplus materials supplied by Company shall be collected by the Contractor and delivered to Company's warehouse as mentioned elsewhere in the Contract. Contractor shall keep a record of all materials returned to Company and shall submit the same for Company information.

14.4 Disposal

All surplus and defective materials supplied by Contractor and all trash, refuse and spoiled material shall not be disposed of from the vessels into the surrounding water but shall be collected and disposed of by Contractor in a manner satisfactory to Company.

The right of way at shore approaches shall be cleared of all rubbish, broken skids, empty cans, cardboard, sacks, stumps, trash and leftover construction material.

Surplus soil can only be removed from the work area after authorization by Company Representative.


All loose stones and rock exposed by the construction operations and scattered over the right of way or adjacent grounds shall be removed by the Contractor and be transported to a location considered suitable by the Authorities having jurisdiction, for satisfactory disposal.

15.0 AS-BUILT DATA REQUIREMENTS

15.1 On completion of hydrostatic testing, the Contractor shall prepare "As Built Drawings and Reports for all pipeline systems. It shall be the responsibility of Contractor to carry out an accurate survey of the installed pipelines and to provide detailed "As Built" alignment drawings to include any departure from the specified alignment, details of unsupported span, etc. within four weeks after completion of construction. For this purpose the already approved drawings by Company shall be used for incorporating the as-built data. As-built data shall be collected by carrying out a geophysical survey of the installed pipeline subsequent to the completion of the pipeline installation, using echo sounder, side scan sonar, sub bottom profiler etc. Preparation and submission of new as-built drawings is not acceptable to Company, in case "Issued for Construction" drawings already exist.

15.2 Alignment details shall be obtained from plotted data taken during construction and post-construction surveys. All pertinent data such as pipeline appurtenances, fittings, crossings, unsupported spans, burial details, location of anodes, location of laterals/on-

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line valves/PLEMS, elevation of riser clamps, Monel sheathing details hanger flange and insulating joint details etc. shall be accurately located on the “As-built” drawings. Exact placement, location and orientation of all risers, lateral, stub ends, mechanical connectors, flanges, etc. shall also be indicated on the “As-built” drawings.

15.3 Contractor shall provide divers and saturation diving facilities as required to inspect and verify the areas where the pipeline/appurtenances are installed on the sea bed viz. On-line valves locations, lateral locations, PLEM locations, expansion loop locations etc. All diver operations shall be monitored by close circuit TV/monitor and underwater cameras. Contractor shall make video recordings of underwater surveys performed by divers.

15.4 The Contractor shall also prepare an “As –Built” Report including the following as a minimum.

- a) Pipeline installation record indicating pipeline material, diameter, wall thickness, reference to pipe tally sheet numbers, length of such pipe, cumulative length, weld joint number, NDT results.
- b) Pipeline alignment/route maps with 1:5000 scale, approaches to platforms with 1:500 scale, piping drawings for laterals, on-line valves assemblies, pipeline end manifolds with 1:33 1/3 scale.
- c) Burial details along the pipeline route including the Platform approaches and shore approaches.
- d) Riser detail drawings showing riser make-up, pipe material, diameter, wall thickness, weld joint number, details of coating, riser bend radius and angle, approach angle to platform, location/elevation of riser clamps, field joints, anodes, Monel sheathing, splash zone extent and protection, etc.
- e) Location of anodes, and post-installation potential measurement survey report.
- f) Location and details of stub-ends/lowering heads.
- g) Location and details of laterals, on-line valves, PLEMS, expansion loops, etc.
- h) Spanning of pipelines, if any and remedial measures undertaken.
- i) Corrosion and concrete coating details for the pipelines and risers.
- j) Details of field joints
- k) Pipeline crossing details including the grout bag/support details.
- l) Other miscellaneous details, such as diary of events, list of video tape recordings, photographic records, etc.

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m) Details of the expansion loop installed, if applicable.

The “As-built” documents, drawings, reports and all video recordings for each pipeline system shall be submitted to the Company as per the requirement laid down in Sec 9.5 of Vol. 1 of the bid.

15.5 In addition to the above, the Contractor shall obtain the Project Data base formats from the Company and suitably fill the same with the relevant data of the project carried out.


15.6 Contractors shall also furnish to Company the line wise statistical details of the lay rate, weld repairs (no. of joints as well as the length of repair), barge down time due to weather as well as mechanical break-down, etc. as a part of the as-built documentations.

16.0 DOCUMENTATION

16.1 Contractor shall furnish the technical documents, including the following as a minimum, required for installation of pipeline and related facilities:

- a) Description of the complete marine laying spread, including diving and other underwater system suitable for maximum and minimum water depths involved in the scope of work.
- b) Brief description of the proposed laying methods, welding methods, welding and tie-in procedures including welding inspection and repair procedures.
- c) All geometrical characteristics and data of pipe laying equipment with sufficient details as per the Fig. No. 16.1, in order to enable the Company to verify all calculations and analysis on the proposed pipe laying system.
- d) Positioning system to be used to ensure that the pipeline is installed along the designated route along with the accuracy of positioning.
- e) Complete list of manpower, tools and equipment proposed to be used.
- f) Description of equipment and procedures used for the pipeline repair in case of any buckle.
- g) List of possible suppliers, sub-contractors along with relative supply, activity or work to be sub-contracted and summary of previous references of similar activities in the last five years.
- h) General organization or work, spread, supplies and transport.
- i) Calculations and technical report on proposed laying procedures showing the stress level conditions as well as the configuration, which are anticipated in the pipeline during laying operations. In particular, the Contractor shall calculate the main laying parameters referring to the most severe condition in order to assess the capability of the pipe laying equipment (mainly the tensioning device and winch).

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- j) Post-construction survey method to establish and prepare 'as-laid/as- built' drawings upon completion of construction.
- k) Expected line wise rate of laying (km/day) for each pipeline.
- l) Details of the complete proposed shore approach pipe laying spread (if applicable) including the marine and land based equipment.
- m) Proposed direction of pipe laying for each pipeline.
- n) Proposed method of pipe laying at shore approaches.
- o) Details of the proposed cathodic protection surveys.
- p) Details of the computer programs proposed to be used for the various analyses.
- q) Reference list of similar installation works carried out by the Contractor using the proposed marine spread, including all relevant details viz. Project, Year, Client, Location, Size, Service, Water depth, Concrete coating thickness, Average lay rate per day attained, etc. in the fast five years.

16.2 Contractor shall prepare and submit for Company approval, the following documents with sufficient details as enumerated herein below, at least eight weeks before commencement of respective works at the site:

16.2.1 Procedures

- a) Pre-engineering survey, if applicable
- b) Pre-construction survey
- c) Welding and welder qualification procedures
- d) Survey Positioning Procedure
- e) Pipeline Installation Procedure
- f) Riser Installation Procedure
- g) On-line valves, Lateral Assembly, PLEM Installation and Expansion Loop Installation Procedures (as applicable).
- h) Anchor handling procedure and Anchor pattern to be adopted in the vicinity of the existing installations.
- i) Diving procedures.

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- j) Method of pipeline repair in case of dry buckle/wet buckle.
- k) Abandonment/Recovery procedures to be adopted in case of contingencies.
- l) Procedure to ensure the spacing between the pipelines, in case of parallel lines.
- m) Survey procedure to establish and prepare 'as-laid/as-build' drawings upon completion of installation.
- n) Cathodic protection survey procedures.
- o) Umbilical installation procedure (if applicable)
- p) Trenching and back-filling procedure (if applicable)
- q) Hydrostatic testing procedure (if applicable)

16.2.2 Calculations

- a) Pipeline stress analysis during installation.
- b) Riser stress analysis during installation.
- c) On-line valves, lateral assemblies and PLEM stress and stability analysis.
- d) Abandonment/recovery stress analysis
- e) Stress analysis of pipeline crossing
- f) Stress analysis for the free spans/free span calculation
- g) Transportation analysis


16.2.3 Design Documents

- a) Design of the pipeline crossings
- b) Design of PLEM, on-line valves and lateral assemblies.
- c) Umbilical route and stability analysis (if applicable)
- d) Design of cathodic protection of PLEM and protective cages for on- line valves, lateral and PLEMS assemblies (as applicable).

16.2.4 Material Details

- a) Details of all materials to be furnished by Contractor including the following as a minimum:

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- Complete technical documentation of the material including catalogs, test certificates, drawings etc. for various proposed Manufacturers/Vendors.
- Reference of list of previous similar supplies in the past five years.
- Any other documents specially listed in the Company Material Specifications for Submarine Pipelines.

17.0 DAILY REPORTS

Daily progress reports on laying operations shall be given to the Company Representative on-board and communicated to the Company's office onshore on a daily basis. This shall include as a minimum the following:

- Designation of the pipeline section being laid.
- Barge location/co-ordinates along with chainage
- Number of joints laid in the last 24 hrs.
- No. of weld repair, and barge time lost in weld repair
- Quality of field joint coating operations.
- Weather status
- Any other relevant details

18.0 SUPPLY OF MATERIALS

Contractor shall be responsible for supply of all materials (other than those supplied by Company as free issue materials to Contractor) and consumable required for completion of works in all respects, in compliance with the requirements of this specification.

All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant applicable Company Materials Specifications and shall include, as a minimum, the following:

- a) Welding electrodes and all other consumables.
- b) All materials and equipment for coating field joints and repairing damaged yard applied coating.
- c) All pipe supports, hanger flanges, clamps, etc. necessary for the installation of the pipeline.
- d) All support bags and spacers for the pipeline crossings and free spans.
- e) Any other material required to complete the works in all respect.

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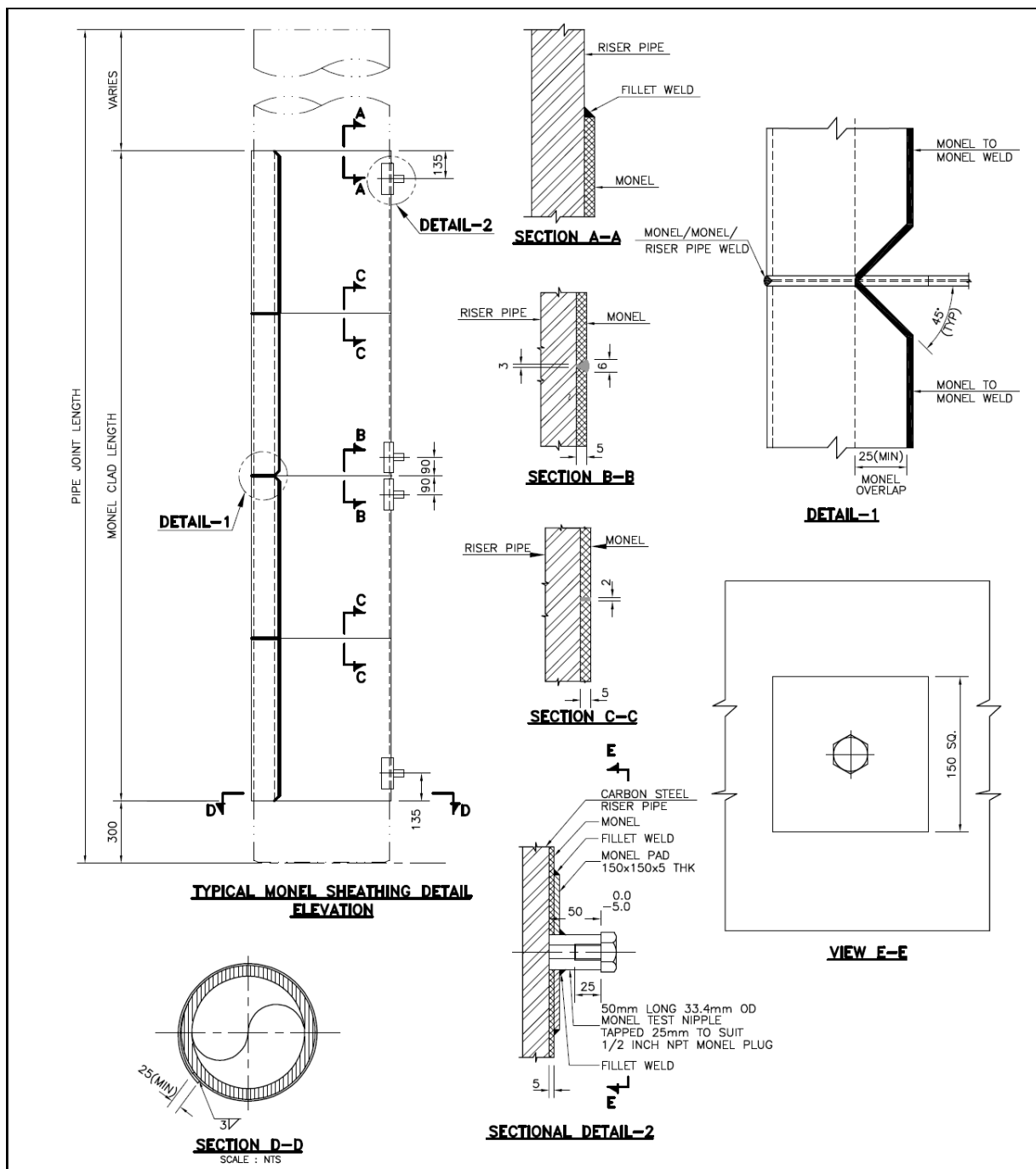
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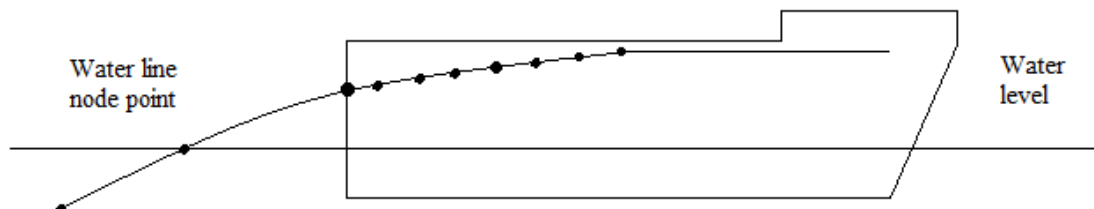
Fig. 8.13.4



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Fig. 16.1

Tensioner





LAYING CONFIGURATION


	Barge	Stinger
SUPPORT No.		
X-Coordinate		
Y-Coordinate		
STRESS % SMYS		


OTHER DATA

1	Pipe Outside Diameter (inch)	
2	Pipe Wall Thickness (mm)	
3	API Steel Grade	
4	Concrete Coating Thickness (mm)	
5	Weight in Air (kg/m)	
6	Submerged Weight (kg/m)	
7	Angle of Tensioner (degrees)	
8	Barge Tension	
9	Bottom Tension	
10	Water Depth (m)	
11	Maximum Pipe Stress (% SMYS)	

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B.P.M			REPRODUCED FROM REV.0 & ISSUED FOR BID	13	10.05.04	0										
A.K.M.			REPRODUCED FROM REV.0 & ISSUED FOR BID	11	23.7.03	0										
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<p>1.0 SCOPE</p> <p>This specification covers the minimum requirements for manufacture and supply of long radius bends made from carbon steel line pipes for use in submarine pipeline systems handling sour/non-sour hydrocarbons in liquid or gaseous phase and injection water.</p> <p>2.0 REFERENCE DOCUMENTS</p> <p>Reference has been made in this specification to the latest edition of the following codes, standards and specifications:</p> <ul style="list-style-type: none"> a. ANSI B 31.8 : Gas Transmission and Distribution Piping Systems b. ANSI B 31.4 : Liquid Petroleum Transportation Piping System. c. MSS-SP-75 : Specification for High Test Wrought Welding Fittings d. DNV 1981 : Rules for Submarine Pipeline Systems e. Company Specifications for Line Pipe <ul style="list-style-type: none"> 2020A : Specification for Carbon Steel Seamless line Pipe for submarine Pipelines. 2020B : Specification for Carbon Steel Seamless Line Pipe (Sour Service) for Submarine Pipelines. 2020C : Specification for Carbon Steel SAW Line Pipe for Submarine Pipelines. 2020D : Specification for Carbon Steel SAW Line Pipe (Sour Service) for Submarine Pipelines. <p>In case of conflict between the requirements of this specification and the requirements of above referred documents, the requirements of this specification shall govern.</p>				
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3.0

MATERIALS

3.1

Bends shall be fabricated from steel line pipe manufactured in accordance with the latest revision of the Company Specifications referred in Section 2.0. The type of pipe to be used for fabrication of bends shall be as indicated in the Material/Purchase Requisition. Pipes with positive tolerance on wall thickness shall be selected for manufacturer of long radius bends.

3.2

Unless specified otherwise in the material/purchase requisition, The line pipes shall be procured by the Manufacturer.

3.3

All mechanical properties of the bends after finishing shall be same as the relevant pipe specification referred in clause 3.1. The test procedures shall be as per the relevant pipe specification as referred in clause 3.1. The following tests shall be conducted on finished bends:

3.3.1

Tensile Test

One tensile test shall be conducted on the base material of finished bend for each heat of steel used, to establish yield strength, ultimate tensile strength and elongation. The specimen shall be taken longitudinal or transverse to the pipe axis as specified in the relevant pipe specification.

In case of bends of Nom. Dia. 18 inch and larger, the specimen shall be taken one at inside radius and one at outside radius of the bend.

3.3.2


Fracture Toughness Test

Charpy-V-notch impact tests shall be conducted for each heat of steel used at the same temperature as specified in the relevant pipe specifications referred in Clause 2.0.

Three base material specimens shall be taken longitudinal or transverse to the pipe axis as specified in the relevant pipe specification. In case of bends of Nom. Dia. 18 inch and larger, the base material specimens shall be taken at the outside radius of the bend.

Additionally, in case of bends fabricated from SAW pipes, the transverses weld material specimen shall be taken with weld in the middle.

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3.3.3

Guided Bend Test

In case of bends fabricated from SAW pipes, one face and one root guided bend weld test shall be performed on samples cut from one bend per heat of steel.

3.3.4

Hardness Test

Hardness shall be measured "thru thickness", at following locations on the finished bends:

a.

Base metal, HAZ and weld metal.

b.

At spots where dents, bulges or wrinkles have been formed on the bends.

The acceptance values and procedure shall be as per the relevant line pipe specification referred in clause 2.0 of this specification.

4.0

MANUFACTURE

4.1

Bends shall be manufactured by hot bending the pipe using the following method(s):

4.1.1

For pipe nominal diameter 4" though 16", the bends may be manufactured either.

i.

By high frequency induction heating and forming,

OR

ii.

By packing the pipe with dry silica sand and hot bending.

4.1.2


For pipe nominal diameters 18" and larger, the bends shall be manufactured by high frequency induction heating and forming only.


4.1.3


Pre-qualification


The bending procedure shall be proposed by specifying the induction frequency, time, temperature, bending, method and equipment etc. for approval. The approved bending procedure shall be qualified in presence of

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<p>clients or third party inspector. The bending procedure qualification shall include the following tests as specified for the base pipe.</p> <ol style="list-style-type: none">1. Mechanical Testing2. Hardness Testing3. Charpy V Notch Impacting Testing4. CTOD Testing5. HIC Testing NACE TM-02-846. SSCC Test. <p>Separate bending qualifications procedure shall be proposed and qualified for different bending process. The bending execution shall be in accordance with the qualified procedure and shall not be interrupted till the finish. The bends produced by such an interrupted bending shall be rejected.</p> <p>4.2 The temperature prior to and during forming shall be determined by an optical pyrometer. These data shall be recorded for inspection. Hot forming shall be performed above the upper critical temperature of the metal and shall be in the range of 815-995°C. Bends shall be supplied in as normalized condition.</p> <p>4.3 When bending SAW pipes, the weld shall be located at approx. 10⁰ from the neutral zone, measured at outside of the bend as indicated in Figure 4.3.</p> <p>4.4 All bends shall be provided with a tangent length at the ends. In case the angle of the bend is less than or equal to 45 degree, the tangent length shall be 500 mm and for bend angle greater than 45 degree the tangent length shall be 1000 mm.</p> <p>4.5 Bend angle and bend radius shall be as indicated in the Material/Purchase Requisition.</p> <p>4.6 Unless otherwise specified differently in the Material/Purchase Requisition, the bevels at the ends shall be as per the relevant pipe specification.</p> <p>4.7 Bends shall not have any circumferential joint.</p>				
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<p>4.8 No repair by welding is allowed on any part of the bends.</p> <p>4.9 Bulges and dents on the body of the bends (excluding a length of 100 mm from the ends) are permitted from the original contour of the pipe provided these deviations do not exceed 6.0 mm. The same shall not extend (in any direction) over a distance of more than 25% of nominal diameter of the bend.</p> <p>4.10 The excess weld material at the inside of the bend in case of bends made from SAW pipes, shall be removed over a distance of 100 mm at both ends.</p> <p>4.11 Tolerances</p> <p>The dimensions of bends shall be controlled to make sure that they are manufactured according to the tolerances indicated below, in addition to the requirements of MSS-SP-75. However the ends of finished pipe bend shall meet the dimensional tolerances of the relevant pipe specification referred in clause 3.1</p> <p>4.11.1 Bend Angle : (±) 0.5 Degree from the specified angle.</p> <p>Bend Radius : (±) 1% of bending nominal diameter.</p> <p>4.11.2 The Manufacturer shall check the wall thickness of the pipe before and after bending at four uniformly spaced points around the circumference repeated along the entire length of bend, at intervals, either at distances approximately equal to pipe diameter or 300 mm whichever is less. The measured wall thickness shall be at least equal to:</p> <p>t min = 0.95 (t nom. - t)</p> <p>t nom= nominal wall thickness as specified in the material/purchase requisition.</p> <p>t = 0.35 mm for a wall thickness smaller than 10 mm</p> <p>t = 0.50 mm for a wall thickness 10 mm or more.</p> <p>4.11.3 Out of roundness tolerance on the body and ends of the bend shall be as follows:</p>				
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<p style="text-align: center;">Body</p> <p>Measurements of the outside diameter shall be taken in the plane of the bend at locations where wrinkles are present (OD max.) and at locations where wrinkles are not present (OD Min.) Out of roundness shall be considered acceptable, if the value of</p> $\frac{\text{OD max.} - \text{OD min.}}{\text{OD nom.}} \text{ does not exceed } 2\%.$ <p>The measurements shall be made over the circumference of the bend either at distances approximately equal to pipe diameter or 300 mm whichever is less.</p> <p style="text-align: center;">Ends</p> <p>Out-of-roundness over a length of 100 mm from the end shall comply the requirements of relevant company specification referred in clause 3.1.</p> <p>5.0 INSPECTION AND TESTS</p> <p>5.1 The Manufacturer shall perform all inspection and tests as per the requirements of this specification and MSS-SP-75 prior to shipment, at his works. Such inspection and tests shall be, but not limited to the following:</p> <ol style="list-style-type: none"> a. Verify that the unfinished product arriving at Manufacturer's shop is in full compliance with the pipe specification as referred in clause 3.1 of this specification. b. Visual Inspection. c. Dimensional and tolerances check as per MSS-SP-75 and requirements of Section 4.0 of this specification. d. Check heat treatment, if carried out, as required and maintain its records. e. Temperature against time recorder charts for each induction heating. 				
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f. Material properties shall be checked to meet the requirements of Section 3.0 of this specification.

g. The non-destructive inspection on the finished bend shall be carried out as given below:

- All seam weld of bends fabricated from longitudinal SAW line pipe shall be fully radiographed and acceptance limits shall be as per pipe specification as referred in clause 3.1 of this specification.
- The full circumference of both ends of each bend after bevelling shall be ultrasonically tested for laminations over a length of 25 mm and acceptance limits shall be as per pipe specification as referred in clause 3.1 of this specification.

h. Bend shall be subjected to hydrostatic test at a pressure equal to the test pressure indicated in the relevant line pipe specification mentioned in clause 3.1.

i. Gauging pig shall be passed through each bend to demonstrate the compliance to the out of roundness requirements mentioned in Section 4.0 of this specification. Diameter of the gauging pig (Dg) shall be calculated using the following formulae:

Dg = D-2 t-S

Where

S = 0.01D + 0.4 t + 5I


D = Nominal outside diameter of pipe


t = Nominal wall thickness of pipe


I = 20% of t, max. 5 mm

5.2 Company's Inspector reserve the right to perform stage wise inspection and witness tests on all bends as indicated in clause 5.1 at Manufacturer's works, prior to shipment.

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<p>Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector. Inspection and tests performed or witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests. Under no circumstances any action of the Purchaser's Inspector shall relieve the Manufacturer of his responsibility for the material and quality of the bends.</p>				
6.0	TEST CERTIFICATE			
<p>The Manufacturer shall submit the following Certificates:</p>				
<p>a. Certificates of chemical analysis, mechanical tests, corrosion tests, NDT, dimensional inspection and hydro test carried out on pipe used for fabrication of bends.</p>				
<p>b. Certificates of mechanical tests including hardness tests carried out on finished bends.</p>				
<p>c. Certificates of required non-destructive test inspection for bends.</p>				
<p>d. Certificates of heat treatments, if any for bends.</p>				
<p>e. Certified reports of hydrostatic test for bends.</p>				
<p>f. Certified reports of dimensional tolerance for bends.</p>				
<p>g. Certificates of all other tests as required in this specification.</p>				
<p>The certificates shall be valid only when signed by Company's Inspector. Only those bends which have been certified by Company's Inspector shall be dispatched from Manufacturer's work.</p>				
7.0	MARKING, PACKING AND SHIPMENT			
7.1	All bends shall be marked as per MSS-SP-75.			
7.2	All loose and foreign material i.e. rust, grease, etc. shall be removed from inside and outside of the bends.			
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7.3	A coat of antirust paint shall be applied on the bends for protection during transit and storage. Type of paint shall be as agreed upon with the Purchaser.			
7.4	Both ends of all bends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors.			
7.5	Package shall be marked legibly with indelible marking ink to indicate the following: a. Order Number b. Package Number c. Manufacturer's Name d. Size (Inches) and wall thickness (mm) e. Radius of bend (mm) and bend angle			
8.0	DOCUMENTATION			
8.1	All documents shall be in English language.			
8.2	At the time of bidding, bidder shall submit the following documents: a. Reference list of previous supplies of bends of similar specifications and similar service. b. Clause-wise lists of deviation from this specification, if any. c. Brief description of manufacturing and quality control facilities of the Manufacturer's works.			
8.3	Within three weeks of placement of order the Manufacturer shall submit six copies of the manufacturing and quality control procedures for pipe and bends. Once the approval has been given by Company any change in material and method of manufacture and quality control shall be notified to Company whose approval in writing of all such changes shall be obtained before the bends are manufactured.			
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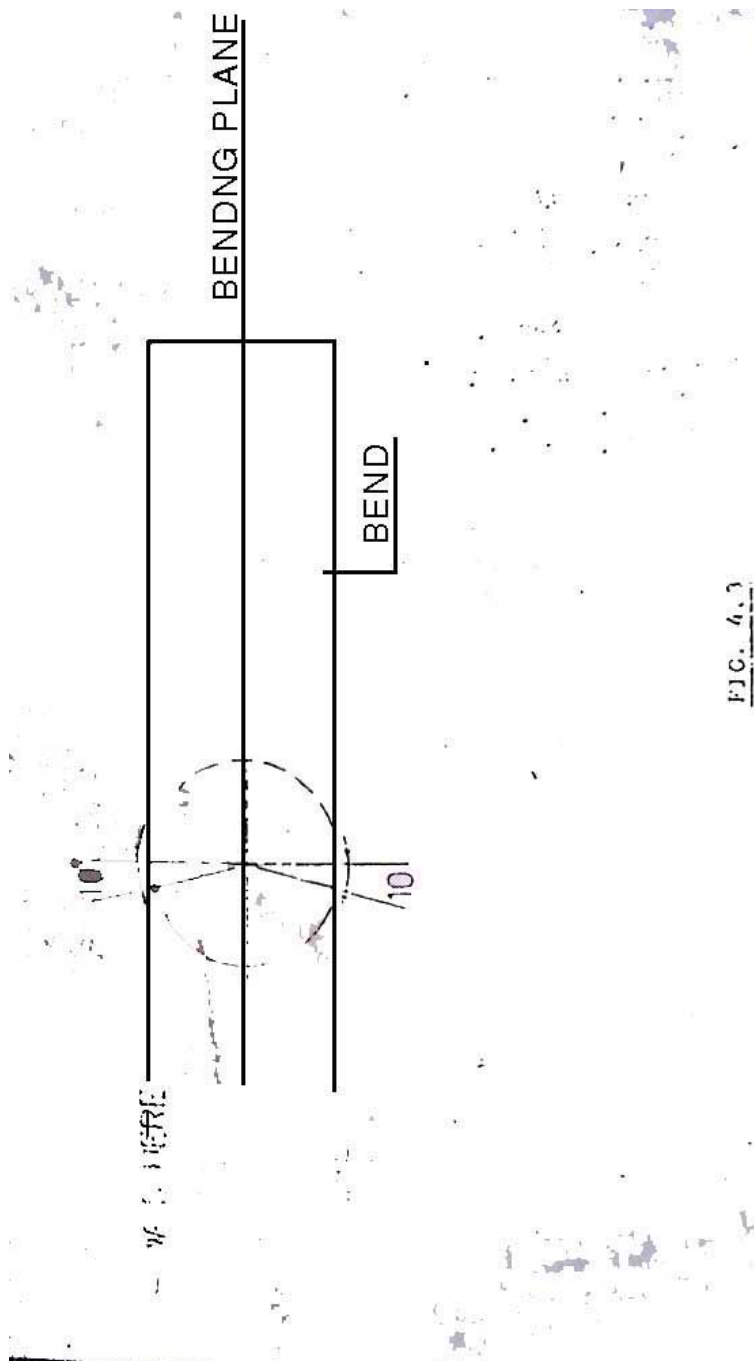
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<div>8.4 Within four weeks from the approval date Manufacturer shall submit six copies of the documents as stated in clause 8.3 above.</div> <div>8.5 Prior to shipment, the Manufacturer shall submit six copies of test certificates as listed in clause 6.0 of this specification.</div>				
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SECTION**

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Offshore Design Section
Engineering Services
ISO – 9001:2008

Functional Specification
for
Carbon Steel Seamless
Line Pipe for Submarine
Pipelines

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**SPECIFICATION
FOR
CARBON STEEL SEAMLESS LINE PIPE
FOR
SUBMARINE PIPELINES**

**OIL AND NATURAL GAS CORPORATION LTD.
INDIA**

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33	19.07.2016	5	
TOTAL NO. OF PAGES	DATE	REV.NO.	



SCOPE

This specification establishes the minimum requirements for the materials, fabrication, inspection, testing and supply of seamless carbon steel line pipe to be used for submarine pipelines and risers transporting non-sour applications. Line pipes furnished in accordance with this specification shall meet the requirements of **API Specification 5L, Forty-Fifth Edition and the supplementary requirements stated herein.**

All carbon steel pipes made according to this specification shall be PSL2.

This specification covers seamless line pipes of pipe diameters up to 406.4 mm OD (16 inches) and grades up to Grade L450 (X65). The Manufacturer shall have the license to use API monogram for manufacturing of pipes in accordance with the requirements of API Spec 5L, **Forty-Fifth Edition.**

“COMPANY” means “Oil and Natural Gas Corporation Ltd.”, wherever used in this specification.

NOTE

The sections, paragraphs contained herein have the same numbering as the sections and paragraphs of API 5L, in order to facilitate reference.

In this Specification, amendments to API 5L fall into the following Categories:

- | | |
|-------------------|--|
| ADD | Where additions have been made to the API 5L clause or paragraph. |
| AMEND | Where the API 5L clause has been modified. Only the modified portions will be detailed in this Specification |
| DELETE | Where the complete clause or paragraph is to be disregarded. |
| SUBSTITUTE | Where the text has been substituted for the complete clause or paragraph in API 5L. |



6 PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe Grade and Steel Grade

6.1.2 ADD

Maximum pipe grade shall be up to Grade L450 (X65), where 450 represents the Yield Strength in MPa.

6.2 Delivery Condition

6.2.2 ADD

The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.

7 INFORMATION TO BE SUPPLIED BY THE PURCHASER

7.1 General Information

The purchase order shall include the following information:

SUBSTITUTE

Sl. no	Information to be provided as per API 5L	Information provided by the COMPANY to be incorporated in PO/PS.
a)	quantity(e.g. total mass or total length of pipe)	As per provisions of the Contract.
b)	PSL (1 or 2)	PSL2
c)	type of pipe (see Table 2)	Seamless
d)	reference to API 5L	API Spec 5L, Forty-Fifth Edition
e)	steel grade (see 6.1, H.4.1.1 or J.4.1.1, whichever is applicable)	J.4.1.1 of API 5L shall be applicable.
f)	outside diameter and wall thickness (see 9.11.1.2)	As per provisions of the Purchase Specification
g)	length and type of length random or approximate) (see 9.11.1.3, 9.11.3.3 and Table 12)	Refer J.6.3 of API 5L of Forty-Fifth Edition
h)	confirmation of applicability of individual annexes.	The applicable Annexes as shown in the following supplementary Table:



Applicable Annexures:

Annex.	Service
Annex B (Amended) -Manufacturing procedure qualification for PSL 2 pipe	Offshore Service
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore Service
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore Service
Annex K (Amended) - Non-destructive inspection for pipe ordered offshore service	Offshore Service

Note: In case of any contradiction between different clauses of this Specification, the most stringent clause shall prevail upon.

7.2 ADDITIONAL INFORMATION

SUBSTITUTE

a)	Items that are subject to mandatory agreement, if applicable:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	pipe designation for intermediate grades [see Table 1, footnote a)]	Not applicable
2	chemical composition for intermediate grades (see 9.2.1 and 9.2.2)	Not applicable
3	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see 9.2.3)	J.4.1.1 of API 5L shall be applicable.
4	carbon equivalent limits for PSL 2 pipe in Grade L415N or X60N (see Table 5)	Refer 9.2.4 & 9.2.5 of this specification.
5	carbon equivalent limits for PSL 2 pipe in Grade L555Q or X80Q, L625Q or X90Q, and L690Q or X100Q (see Table 5),	Not applicable
6	carbon equivalent limits for PSL 2 SMLS pipe with $t > 20,0$ mm (0.787 in) [see Table 5, footnote a)],	Refer 9.2.4 & 9.2.5 of this specification.



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Engineering Services
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7	diameter and out-of-roundness tolerances for pipe with $D > 1422$ mm (56.000 in) (see Table 10)	Not applicable
8	diameter and out-of-roundness tolerances for the ends of SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table 10, footnote b)]	Table 10 of API 5L 45 th Edition is not applicable. Refer J.6.1 of API 5L 45 th Edition.
9	standard applicable to jointer welds (see A.1.2)	Not applicable. Jointers are not permitted.

b)	Items that apply as prescribed, unless otherwise agreed:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	range of sizing ratio for cold-expanded pipe (see 8.9.2)	Not applicable.
2	equation for sizing ratio (see 8.9.3)	Not applicable.
3	chemical composition limits for PSL 1 pipe [see Table 4, footnotes c), e) and f)]	Not applicable.
4	chemical composition limits for PSL 2 pipe [see Table 5, footnotes c), e), f), g), h), i), k), and l)],	Footnote g) of Table J.1 of API 5L is not applicable.
5	yield/tensile ratio for grades L625Q or X90Q, L690 or X100 and L830 or X120 [see Table 7, footnotes g and h or Table J.2, footnotes h and i],	Not applicable
6	estimation and reporting of Charpy shear area (see 9.8.2.3)	Not applicable
7	tolerances for random length pipe [see 9.11.3.3 a)]	Refer J.6.3 of API 5L 45 Th Edition
8	type of thread compound (see 9.12.2.4)	Not applicable
9	type of end face (see 9.12.5.1 or 9.12.5.2)	Section 9.12.5.2 of API 5L shall be applicable.
10	International Standard applicable to Charpy testing (see 10.2.3.3, 10.2.4.3, D.2.3.4.2 and D.2.3.4.3)	Charpy V- notch testing shall be done in accordance with ASTM A370.
11	product analysis method (see	As per Section 10.2.4.1 of API



	10.2.4.1),	5L
12	alternate method for diameter measurement for $D \geq 508$ mm (20.000 in) (see 10.2.8.1),	Not Applicable
13	jointer welding type (see A.1.1),	Not applicable
14	offset of longitudinal pipe weld seams at jointer welds (see A.2.4)	Not applicable
15	repairs in cold-expanded pipe (see C.4.2)	Not applicable.
16	alternate IQI type (see E.4.3.1);	Not applicable.

c)	Items that apply, if agreed:	
Sl. no.	Information to be provided as per API 5L	Information by ONGC to be incorporated in PO/PS.
1	delivery condition (see 6.2 and Table 1)	PSL 1 shall not be applicable. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.
2	supply of quenched and tempered PSL 1 Grade L245 or B SMLS pipe (see Table 1),	Not applicable.
3	supply of intermediate grades [see Table 2, footnote a)]	Not applicable.
4	supply of double-seam SAWL pipe [see Table 2, footnote c)]	Not applicable.
5	alternative to specified seam heat treatment for PSL 1 pipe (see 8.8.1)	Not applicable.
6	supply of SAWH pipe with coil/plate end welds at the pipe ends (see 8.10.3),	Not applicable.
7	supply of jointers (see 8.11)	Not applicable .Jointers are not permitted
8	CVN impact test temperature lower than 0°C (32°F) (see 9.8.2.1, 9.8.2.2 and 9.8.3)	CVN impact test temperature lower than 0°C (32°F) is not applicable.
9	CVN impact test of the pipe body of PSL 2 welded pipe with $D < 508$ mm (20.000 in) for shear fracture area (see 9.8.2.2 and Table 18)	Not applicable.
10	CVN impact test of the longitudinal seam weld of PSL 2 HFW pipe (see 9.8.3 and Table 18)	Not applicable.



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11	DWT test of the pipe body of PSL 2 welded pipe with $D \geq 508$ mm (20.000 in) (see 9.9.1 and Table 18)	Not applicable.
12	DWT test temperature lower than 0°C (32°F) (see 9.9.1)	Not applicable.
13	fraction jointers comprising 2 or 3 pieces for 12 m (40 ft) nominal or 24 m (80 ft) nominal, respectively [see 9.11.3.3.c), d), and e)],	Not applicable.
14	power-tight make-up of couplings (see 9.12.2.3 and 10.2.6.1)	Not applicable.
15	special bevel configuration (see 9.12.5.3)	Not applicable.
16	removal of outside weld bead at pipe ends of SAW or COW pipe [see 9.13.2.2 e)]	Not applicable.
17	weldability data or tests for PSL 2 pipe (see 9.15)	For X65 Grade Pipe only (As per 9.15 of this specification)
18	type of inspection document for PSL 1 pipe (see 10.1.2.1)	Not applicable.
19	manufacturing information for PSL 1 pipe (see 10.1.2.2)	Not applicable.
20	alternative type of inspection document for PSL 2 pipe (see 10.1.3.1)	Refer 10.1.3.1 (Amended) of this Specification.
21	use of transverse test pieces for tensile tests of SMLS pipe, not cold-expanded [see Table 20, footnote c)]	<ul style="list-style-type: none">• For pipe OD > 219.1mm both transverse and longitudinal tensile test shall be carried out. Testing frequency shall be as per this specification.• For pipe OD ≤ 219.1mm the test shall be carried out in longitudinal direction only; however longitudinal tensile testing frequency shall be as per this specification.
22	use of the ring expansion test for transverse yield strength determinations [see 10.2.3.2, Table 19 note c), and Table 20 note d)],	Not Applicable.
23	use of an alternative to macrographic examination (see 10.2.5.2)	Not applicable
24	hardness test during production of EW and LW pipe (see 10.2.5.3)	Not applicable



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25	specific condition to be used for hydrostatic tests for threaded and coupled pipe (see 10.2.6.1)	Not applicable
26	alternate hydro test pressure (see Table 26),	Table 26 of API 5L 45 th Edition is not Applicable. Refer 10.2.6 (Substituted) of this specification.
27	use of minimum permissible wall thickness to determine hydrostatic test pressure (see 10.2.6.7)	Applicable.
28	specific method to be used for determining pipe diameter (see 10.2.8.1)	Clause 10.2.8.1 is Applicable. Further, Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 of API 5L.
29	use of inside diameter measurements to determine diameter and out-of-roundness for expanded pipe with $D \geq 219,1$ mm (8.625 in) and for non-expanded pipe [see 10.2.8.3 and Table 10, footnote c)].	Acceptable. Refer Cl. J.6.1 and Cl.10.2.8.3 of API 5L, 45th Edition).
30	specific method to be used for determining other pipe dimensions (see 10.2.8.7)	Proposed methods shall be subject to COMPANY approval.
31	paint-stencilled markings for couplings (see 11.1.2)	Not applicable
32	additional markings specified by the purchaser (see 11.1.4)	For segregation of pipes additional markings/colour bands may be decided by the LSTK contractors.
33	specific surface or location for pipe markings [see 11.2.2 b) and 11.2.6 b)]	Applicable.
34	die-stamping or vibro-etching of pipe (see 11.2.3)	Only low stress die stamping shall be permitted on the pipe bevel face preferably at the opposite end to pipe stencilled markings. The low stress marking shall be the unique pipe number only. Cold die stamping is not permitted on the pipe body.



		In case low stress die-stamping on bevel face is technically not feasible, alternate measures shall be made for providing unique pipe number for ensuring traceability of pipes.
35	alternative location for marking the pipe (see 11.2.4)	Marking shall be carried out at the pipe mill. Further, for pipes intended for subsequent coating, LSTK contractor shall submit the procedure for marking at coating yard ensuring the traceability of pipes.
36	alternative format for pipe length marking locations (see 11.2.6a),	Not applicable.
37	colour identification for pipe (see 11.2.7)	As per 11.2.7 of API 5L.
38	multiple grade marking (see 11.4.1),	Not applicable.
39	temporary external coating (see 12.1.2)	Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.
40	special coating (see 12.1.3)	Not applicable
41	lining (see 12.1.4),	Not applicable
42	manufacturing procedure qualification for PSL 2 pipe, in which case, Annex B shall apply (see B.2),	Refer Annex B (Amended) of this specification.
43	radiographic inspection of SAW seam or coil/plate end seam (see Table E.1)	Not applicable
44	non-destructive inspection of PSL 1 SMLS pipe (see E.3.1.2),	Not applicable
45	NDT of EW seam welds after hydrotest [see E.3.1.3 b)],	Not applicable
46	ultrasonic inspection of welded pipe for laminar imperfections at pipe ends (see E.3.2.3)	Not applicable
47	ultrasonic inspection of SMLS pipe for laminar imperfections at pipe ends (see E.3.3.2)	Refer Annex.K (Amended) of this Spec.
48	radiographic inspection in	Not applicable



	accordance with Clause E.4,	
49	use of both holes and notches in ultrasonic reference standard (see Table E.7),	Acceptable
50	alternative re-inspection technique for COW seams (see E.5.5.5)	Not applicable
51	ultrasonic inspection for laminar imperfections in the pipe body of EW, SAW or COW pipe (see Clause E.8)	Not applicable
52	ultrasonic inspection for laminar imperfections along the coil/plate edges or the weld seam of EW, SAW or COW pipe (see Clause E.9)	Not applicable
53	supply of welded couplings on pipe with $D \geq 355,6$ mm (14.000 in) (see F.1.4)	Not applicable
54	application of Annex G to PSL 2 pipe where purchaser shall specify the toughness test temperature, the minimum energy for each test and the minimum average energy value required for the order (see G.2),	Refer 9.8.2.1 (Amended) of this specification
55	PSL 2 pipe for sour service, in which case, Annex H shall apply (see H.2),	Not Applicable
56	TFL pipe, in which case, Annex I shall apply (see I.2),	Not applicable
57	pipe for offshore service, in which case, Annex J shall apply (see J.2),	Refer Annex J (Amended) of this specification
58	any other additional or more stringent requirements.	As included within this document.


8 MANUFACTURING

8.1 Process of Manufacture

ADD

This specification is applicable for seamless pipe only. Other types of pipes specified in Table 2 and pipe for intermediate grades (refer footnote a) of Table 2 are not applicable in this specification. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.

8.3 Starting Material

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8.3.2 AMEND

Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed.

Steel shall be made by continuous casting only. Pipes shall be seamless construction. Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.

8.3.3 ADD

The steel shall be fully killed and made with fine grain structure with a grain size of ASTM 7 or finer as per ASTM E 112.

8.9 Cold Sizing and cold expansion

SUBSTITUTE

Cold expansion shall not be permitted for seamless pipes.

8.11 Jointers

AMEND

Jointers shall not be permitted.

8.12 Heat Treatment

ADD

The pipes shall be “normalized” or “normalized and tempered” or “quenched and tempered”. Other types of heat treatment shall be agreed upon between the COMPANY and Manufacturer. Temperature of furnace shall be controlled and recorded and such records shall be accessible to Company.

9 ACCEPTANCE CRITERIA

9.2 Chemical Composition

9.2.4 SUBSTITUTE

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For steels with carbon content $\leq 0.12\%$, the PCM value based on product analysis shall be limited to Table J.1 of API 5L but in no case shall exceed 0.21, when calculated using the formula given below:

$$CE_{Pcm} = C + \frac{Ni}{60} + \frac{Si}{30} + \frac{Mn+Cu+Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

9.2.5 SUBSTITUTE

For steel with carbon content $> 0.12\%$, the Carbon Equivalent (CE) based on product analysis shall be limited to Table J.1 of API 5L but in no case shall exceed 0.40, when calculated using the formula given below:

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

9.8 CVN Impact Test for PSL 2 Pipe

9.8.1 General

ADD

The Manufacturer shall perform the Charpy V-notch tests in accordance with the latest edition of ASTM A 370 using absorbed energy criteria and the requirements mentioned herein.

Flattening of specimens shall not be permitted. Specimens shall be taken in a transverse direction. When it is not feasible to secure even half-size specimens in transverse direction because of pipe size or wall thickness, test specimens shall be taken in a longitudinal direction to pipe axis. The energy requirements for longitudinal specimens shall be 1.5 times those of transverse specimens as detailed in 9.8.2.1(Amended) of this specification.

In addition, CTOD tests shall be carried out as per the requirement of the first day production tests. Refer Annex B (Amended).

9.8.1.3 AMEND

Tests shall be conducted at 0°C (32°F)

9.8.2 Pipe Body Tests

9.8.2.1 AMEND

The minimum average (of a set of three test pieces) and minimum individual absorbed energy for each pipe body test shall be as given in Table 8



(substituted), based upon full-size test pieces and a test temperature of 0 °C (32 °F). Test temperature lower than 0°C (32°F) is not applicable.

TABLE 8 (SUBSTITUTED)

API 5L Table-8 is substituted as under:

Grade	Min. Average	Min. Individual
X-42	29J	22J
X-46	32J	24J
X-52	36J	27J
X-56	39J	29J
X-60	41J	31J
X-65	43J	33J

Note: The average impact values are determined by finding the mean of the values of each group of three specimens from each sample taken separately. The minimum impact value is determined by considering the values of the individual specimens from the sample.

9.10 Surface Conditions, Imperfections and Defects

9.10.1 General

9.10.1.2 ADD

No cracks shall be permitted. Section of the pipe containing cracks shall be cut off as per the requirement of clause C.3(b) or entire pipe length shall be rejected as per the requirement of clause C.3.(c) of API 5L.

9.10.1.3 AMEND

The acceptance criteria for imperfections found by non-destructive inspection shall be in accordance with Annex K (amended) of this specification.

9.10.2


(c) AMEND

Undercuts that exceed the limits specified in item b) shall be classified as defects and shall be treated in accordance with API 5L para C.3 (b) or (c).

9.10.4 Laminations

ADD

Refer Annex K (Amended).

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9.10.5 Geometric Deviations

9.10.5.2 AMEND

Depth of dent shall not exceed 2 mm and length in any direction shall not exceed half of the pipe diameter, provided this dent does not give rise to a hard spot at the internal surface exceeding 250 HV10. Disposition of dents shall be carried out in accordance with API 5L para C.3.b) or C.3.c) of Annex C.

9.10.6 Hard Spots

SUBSTITUTE

Any hard spot larger than 50 mm (2.0 in) in any direction shall be classified as a defect if its hardness exceeds 250 HV10 based upon individual indentations. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C (Amended).

9.10.7 Other Surface Imperfections

SUBSTITUTE

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

- (a) Imperfections that have a depth $\leq 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1.
- (b) Imperfections that have a depth $> 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as defects and shall be dressed –out by grinding in accordance with Clause C.2 (Amended) or shall be treated in accordance with Clause C.3.
- (c) Imperfections that encroach on the minimum permissible wall thickness shall be classified as defects and shall be treated in accordance with Clause C.3.


9.11 Dimensions, Mass and Tolerances

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

AMEND

Tables 10, 11 & 12 of API 5L shall not be applicable.

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9.11.3.1 SUBSTITUTE

Tolerances for diameter and out-of-roundness shall be as per Tabl3 J.3 of API Specification 5L.

9.11.3.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table 11 shall not be applicable.

9.11.3.3 Refer J.6.3 of API 5L

9.11.3.4 SUBSTITUTE

The tolerances for straightness shall be as per J.6.4 of API Specification 5L

9.15 Weldability Test for PSL2 Pipe


Amend

FOR GRADE X-65 ONLY Manufacturer shall carry out a weldability test to establish that quality girth welding meeting various requirements mentioned in this specification can be achieved under simulated site conditions. This test shall be carried out using pipes from any of the first three heats with highest carbon equivalent for each wall thickness and each grade of steel specified in the purchase order. In case more than one mill is proposed to manufacture pipes, the weldability test shall be carried out for each mill.

Welding procedure shall comply with the requirements of DNV-OS-F101. Procedure for field weldability test shall be submitted by the manufacturer in line with DNV-OS-F101and approved by purchaser prior to commencement of test.

Weldability test shall include all tests listed in DNV-OS-F101 aimed at establishing the weld quality/ properties as per this specification. The acceptance criteria shall be as per the requirements of this specification. In case of failure of any test results to comply the specification requirements, manufacturer shall revise the welding procedure adopted and carry out the tests again to comply the specification requirements. Manufacturer shall submit the test results to purchaser to comply specification requirements prior to shipment of pipes.

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10 INSPECTION

10.1.3. Inspection documents for PSL 2 pipe

10.1.3.1 AMEND


Inspection certificate shall be issued and validated as per “3.1C” in accordance with ISO 10474 : 1991.

10.1.3.2 SUBSTITUTE

The manufacturer shall provide production report including acceptance test certificates as mentioned in 13 of API Specification 5L (as applicable for seamless pipe) in six copies, which shall include the results of all testing required as per this specification and performed on raw material and delivered pipes giving details of, but not limited to the following for each pipe length:

- COMPANY's Name and Order Number;
- SUPPLIER's Identification;
- Name and location of facilities used for pipe manufacturing and steelmaking
- Pipe specified outside diameter, specified wall thickness, pipe grade
- Product Specification Level (PSL) and delivery condition;
- Steelmaking Process;
- Identification of Steel Type and Grade;
- Billet number, as applicable;
- Certificates of Product and Ladle Analysis;
- CE_{IIW} & Pcm for both Product and Ladle Analysis;
- Pipe Identification number, Heat number, Pipe length and Pipe weight
- Certified measurements for Dimensional measurements/ tolerance
- Mechanical Test Certificates, including hardness surveys;
- Yield/Tensile Ratio (based on R_{10.5});
- Pipe Elongation;
- Charpy Impact Results;
- Hardness Tests;
- Heat Treatment Condition
- Hydrostatic Test Certificate, or statement;
- NDT Procedures and Results;
- Surface Inspection;
- Dimensional Control Checks;
- Manufacturing Procedure Specification and Qualification Tests;
- Hardness test and CTOD test records;
- Information on production & shipping

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- All other reports and results as required as per this specification
- NDT Operator Qualification Certificates;
- Inspection certificate issued and validated by Authorized representative of Purchaser, as per “3.1C” of ISO 10474 : 1991, in accordance with this specification.
- COMPANY Authorized representative’s Pipe Inspection and Release Note.

Such documents shall indicate pipe identification number, the origin of each individual test specimen etc. and shall be written in English only. International system of units (SI) shall be adopted. The certificates shall be valid only when signed by Company Representative. Only those pipes which have been certified by Company Representative shall be dispatched from the pipe mill.

Manufacturer shall also provide information on test failure / rejected heats etc.

10.2 Specific Inspection

10.2.1 Inspection frequency

10.2.1.2 AMEND

The inspection frequency shall be as given in Table 18 of API 5L, 45th Edition modified by Table J.6 of API 5L, 45th Edition and Table J.6 (Amended) of this Specification.

10.2.2 Samples and test pieces for product analysis.

ADD

Product analysis shall be carried out from finished pipes.


10.2.3 Samples and test pieces for mechanical tests.

SUBSTITUTE

10.2.3.1 For tensile tests, CVN impact tests and CTOD tests, the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in J.8 of this specification,

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taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4. and J.8.2.2.

10.2.6 Hydrostatic Test

10.2.6.1 SUBSTITUTE

The test pressure for all sizes and grades of pipes shall not be less than the maximum pressure calculated based on either of the criteria mentioned at 10.2.6.5 (amended) and 10.2.6.6 (amended) .The test pressure shall be held for a minimum period of 10 seconds for all sizes and grades of pipes.

10.2.6.2 AMEND

The Test pressure measuring device used for hydrostatic testing shall be calibrated with a Dead Weight tester and the record shall be maintained. Calibration records shall be furnished to Company Representative. The calibration shall be conducted at start of a run and after a hydrostatic burst/leak failure

10.2.6.5 AMEND

The required test pressure shall produce a hoop stress of at least 90% of the specified minimum yield strength for all the grades and sizes.

10.2.6.6 AMEND

In case, pressure testing involves end sealing ram, the required test pressure shall produce a hoop stress of at least 95% of the specified minimum yield strength for all the grades and size.

10.2.7 Visual Inspection

10.2.7.1 AMEND


Each pipe shall be visually inspected to detect surface defects, with an illuminance of at least 300 lx (28 fc). Such inspection shall be over the entire external surface and shall cover as much of the internal surface as is practical.

10.2.7.2 DELETE

10.2.7.4 AMEND

Maximum hardness in suspected hard spots shall be 250 HV10. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C.

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10.2.8 Dimensional testing

10.2.8.1 ADD

Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 of API 5L.

10.2.8.5 AMEND

The wall thickness at any location shall be within the tolerances specified in para 9.11.3.2 of this specification.

10.2.10 SUBSTITUTE

Non-destructive inspections shall be in accordance with Annex K (Amended).

10.2.11 SUBSTITUTE

Reprocessing is not permitted.

10.2.12 Retesting (SUBSTITUTE)

10.2.12.1 Recheck Analysis

If any parts of the full product analysis on any one of the fully analyzed pipes fail to meet the requirements of J.4.1 of this specification, either the whole heat shall stand rejected or each individual pipe shall be fully analyzed and all pipes failing to meet the requirements of J.4.1 of this specification shall be rejected.


10.2.12.2, 10.2.12.6 & 10.2.6.7

Tensile retest, Charpy retest and Hardness retest

In case one of the test specimens fails to conform to the specified requirements, a retest on four additional pipes from the same lot shall be made. If all re-tests give positive result, then the pipe, which gave the negative result, shall be rejected and the balance lot shall be accepted.

In case of negative result of one of the re-test specimens, the lot may be rejected or each of the remaining lengths shall be tested individually. The pipes, which give results as per requirement of this specification, shall only be accepted.

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11.2 Pipe markings

11.2.1 ADD

Marking shall be in English using SI units. Markings shall also include API monogram, purchase order number, item number, heat number, wall thickness (mm), pipe number, weight and grade. Weight marked shall be the actual weight of the pipe.

12. Coatings and thread protectors

12.1.2 AMEND

Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.

12.3 Bevel Protectors (New)

Both pipe ends of all pipes shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard

13 Retention of Records

ADD

In addition to the records indicated in clause 13, the manufacturer shall retain the records of all additional tests mentioned in this specification including the ultrasonic testing carried out on pipe as well as pipe ends.

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Annex B (Amended) - Manufacturing procedure qualification for PSL 2 pipe	Offshore Service
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore Service
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore Service
Annex K (Amended)- Non-destructive inspection for pipe ordered for sour service and/or offshore service	Offshore Service

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Annex B (AMENDED)

Manufacturing Procedure Qualification for PSL 2 Pipe

B1.3 (Amend)

Verification of manufacturing procedure qualification shall be carried out in accordance with the fulfilment of Clause B.3, B.4 & B.5 of this specification.

B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION


SUBSTITUTE

A Manufacturing Procedure Specification (MPS) outlining the successive steps and associated inspection procedures from steelmaking to finished line pipe shall be prepared and submitted to Purchaser for approval prior to start of production. Manufacture of pipes shall start only after the approval of Manufacturing Procedure. The approved Manufacturing Procedure shall be strictly followed in all phases of the production of pipes.

The Manufacturing Procedure shall as a minimum include the following information:

- Steel maker and plant at which billet is produced.
- Type of Furnace, Equipment and process description including steel making process with details of secondary refining process and continuous casting process, nominal weight of each heat, deoxidation practices and inclusion shape control practices.
- Target chemistry, range of intentionally added elements and those listed in Table J.1 of API 5L, 45th Edition, limits on heat and product analysis to be placed on steel maker.
- Steelmaking and casting process control.
- Hydrogen control practices for billets.
- Product identification and traceability practices;
- Product rework/retest/release controls for non-conformances to manufacturer's documented practices including grade intermixes/transitions and process/chemistry deviations;
- Centerline segregation controls and acceptance criteria, as applicable.
- name/location of pipe manufacturing facility.
- equipment and process description of pipe manufacturing facility;
- Heat treatment procedure document established as per para 8.12.
- Ultrasonic testing of pipes using automatic and manual equipment including details of equipment, techniques, scanning pattern, probe

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frequency, scanning sensitivity, reference standard for calibration, dynamic calibration procedure, method of marking defects and indicating loss of coupling, inspection and recording.

- NDT Procedures and Equipment Calibration
- Pipe making procedure including plate edge preparation, forming and any other special process proposed.
- Testing of chemical, mechanical and corrosion, macrographic and metallographic properties
- Dimensional tolerances, frequency of checking, measurement and record in a tabular form including details of instruments and equipment proposed.
- End cropping practices;
- Hydrostatic testing including details of testing equipment, procedure and the relevant test pressure calculations including calibration/verification of equipment.
- Marking, storage and transit protection coating procedures
- product traceability practices from billet receipt to pipe delivery;
- product rework/retest/release controls for non-conformances to manufacturer's documented
- practices (including process, chemical/ mechanical, and dimensional deviations),
- Handling, storage, loading and shipment procedure.
- Production report formats.
- Complete details of computerized pipe tracking system.
- Project specific quality control plan

B.5 Manufacturing procedure qualification tests (MPQT)


B.5.1 (Amend)

MPQT/ FIRST DAY PRODUCTION TESTS

The MPS shall be qualified for each pipe nominal diameter either as a part of first day production or as a separate MPQT prior to full scale production. Two lengths of completely finished pipes (in case of only one heat on first day) or two lengths from the first two heats i.e. one pipe from each heat (in case of more than one heat on first day) of first day's production shall be selected at random for testing to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The MPQT/ first day production tests shall be carried out on pipes as per requirement of para B.5.1 (Substituted) of this specification.

The MPQT/ first day's production tests shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser Representative

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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 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 Annexure.

a. Visual Examination

All pipes shall be examined visually for dimensional tolerances and apparent surface defects in accordance with 9, 10 & 11 respectively of this specification.

b. Mechanical Properties

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

c. CTOD Test

CTOD testing shall be carried out in accordance with the requirements of BS7448:1991.

Two sets of specimen with each set consisting of three specimens shall be taken from the base metal with one set in longitudinal direction and other set in transverse direction. The test shall be carried out at 0 °C.

Minimum acceptable critical CTOD value shall be 0.2 mm for BM (Base Metal). Average CTOD values of BM shall be reported. In addition, all the data on fatigue pre-cracking front are required. (Crack length at the following positions i.e. both surfaces 25%, 50% and 75% of the specimen thickness, the minimum and the maximum angle between the crack and the plane of the notch).

d. In addition, all the remaining tests and inspections required to be conducted as per this specification shall be conducted on all the pipes selected for testing during first day production test.

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Annex C (AMENDED)

C.2 Treatment of surface imperfections and defects

C.2.3 Complete removal of defects shall be verified by local visual inspection, aided, where necessary, by suitable non-destructive inspection methods. To be acceptable, the diameter, out of roundness and wall thickness in the ground area shall be in accordance with 9.11.3.1 and 9.11.3.2 of this specification; further, the sum of all ground areas for surface defect treatment shall not exceed 10% of total internal and external surface area of each pipe.



Annex J (AMENDED)

PSL 2 pipe ordered for offshore service

J.2 Additional information to be supplied by the purchaser

Information Requirement

	Information sought by API 5L	COMPANY's Requirement
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see J.3.3.2.1)	Not applicable
b)	ultrasonic inspection of strip or plate for laminar imperfections (see J.3.3.2.4)	Not applicable
c)	supply of helical-seam pipe containing coil/plate end welds (see J.3.3.2.5)	Not applicable
d)	chemical composition for intermediate grades (see J.4.1.1)	Not applicable
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see J.4.1.2)	Table J.1 of API 5L shall be applicable. However, footnote g) of Table J.1 is not applicable.
f)	carbon equivalent limit for steel Grade L555QO or X80QO, L625QO or X90QO, and L690QO or X100QO (see Table J.1);	Not applicable
g)	Chemical composition limits [see Table J.1, footnote d]	Footnote d of Table J.1 of API 5L shall be applicable.
h)	Acceptance criteria for tensile properties if determined at other than room temperature (see J.4.2.2)	Not applicable
i)	for grades equal to or greater than Grade L555 or X80, a lower maximum tensile strength limit may be agreed [see Table J.2, footnote b)];	Not applicable
j)	Minimum average length other than 12,1 m (39.7 ft) and/or different range (see J.6.3)	Refer J.6.3 of API 5L.
k)	Diameter and out-of-roundness tolerances for SMLS pipe with $t > 25.0$ mm (0.984 in) [see Table J.3, footnote b)]	Tolerances shall be as per J.6.1 of API 5L.
l)	Use of inside diameter to determine diameter and out-of-roundness tolerances for non-expanded pipe with $D \geq 219,1$ mm	Acceptable



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	(8.625 in) [see Table J.3, footnote c)]	
m)	hardness test of the pipe body seam weld and HAZ of EW and SAW pipe (see Table J.7);	Not applicable
n)	hardness testing of pipe body for SMLS pipe (see Table J.7);	Required
o)	CTOD testing (see J.8.2.2 and Table J.6);	Refer Annex B (Amended) within this specification.
p)	use of the ring expansion test for transverse yield strength determinations [see Table J.7, footnote c)];	Not applicable
q)	additional longitudinal tensile testing for deep-water pipelay [see Table J.7, footnote d)];	Not applicable
r)	deviation from hardness test [see J.8.3.2.2 c) and J.8.3.2.3];	Not Applicable
s)	deviation from location of hardness test [J.8.3.2.2.c)];	Not applicable
t)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3);	Applicable
u)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Refer K.2.1.3(Amended) and K.2.1.4 (Amended)
v)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4);	Refer K.2.1.4(Amended)
w)	ultrasonic inspection to verify conformance with the applicable requirements given in Table K.1 (see K.3.2.2);	Applicable; Refer K.3.2.2 (Amended).
x)	verification of lamination size/density (see K.3.2.2);	Applicable ; Refer K.3.2.2 (Amended).
y)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3);	Applicable; refer K.3.3 (amended).
z)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4);	K.3.4(Amended) of this specification is applicable
aa)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	K.3.4.1(Amended) is applicable




bb)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Either K.3.4.2 or K.3.4.3 is to be carried out. Refer Annex. K (Amended) of this Spec.
cc)	full-body inspection of SMLS pipe by the eddy current method (see .3.4.3);	Either K.3.4.2 or K.3.4.3 is to be carried out. Refer Annex. K (Amended) of this Spec.
dd)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Not Applicable
ee)	Acceptance Level U2/U2H for non-destructive inspection of the weld seam of HFW pipe (see K.4.1);	Not applicable
ff)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not applicable
gg)	ultrasonic inspection of the pipe body of HFW pipe for laminar imperfections (see K.4.2);	Not applicable
hh)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3);	Not applicable
ii)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux-leakage method (see K.4.4);	Not applicable
jj)	use of fixed-depth notches for equipment standardization [see K.5.1.1 c)];	Not applicable
kk)	radiographic inspection of the pipe ends (non-inspected pipe ends) and repaired areas [see K.5.3 a)];	Not applicable
ll)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4).	Not applicable
m m)	for grades L625QO or X90QO, and L690QO or X100QO, a lower $Rt_{0.5}/R_m$ (see Table J.2).	Not applicable

J.3 Manufacturing

J.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Amended).

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J.3.3 Pipe manufacturing

J.3.3.1 SUBSTITUTE

Steel shall be made by continuous casting only. Cold expansion shall not be permitted for seamless pipes.

J.3.3.2 Not applicable

J.3.3.3 Joints

SUBSTITUTE

Joints are not permitted

J.4 ACCEPTANCE CRITERIA

J.4.2 Tensile properties

J.4.2.1 (Amend)

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

J.4.2.2 DELETE

J.4.3 Hardness test (Amend)

For test pieces subjected to a hardness test the hardness in the pipe body, weld and HAZ shall be ≤ 250 HV10

J.6 Tolerances for diameter, wall thickness, length and straightness

J.6.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table J.4 shall not be applicable.

J.8 Inspection

J.8.1 Specific inspection

SUBSTITUTE

The frequency of inspection shall be as given in Table 18 of API 5L 45th Edition except as specifically modified in Table J.6 of API 5L 45th Edition and Table J.6 (Amended) of this specification.

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Table J.6- Inspection Frequency (Amended)

Type of Inspection	Frequency of inspection ^e
Product Analysis	Two pipes per heat of steel shall be analyzed for all elements listed in Table J.1 of API 5L, 45 Th Edition. When more than 100 pipes are manufactured from one heat, additional product analysis for one pipe shall be carried out for every 100 pipes or less of the same heat.
Hardness testing of the pipe body of pipe with $D < 508$ mm (20.000 in)	Once per test unit of not more than 100 lengths of pipe with the same cold expansion ratio ^a
Pipe diameter and out-of-roundness	Once per test unit of not more than 20 lengths of pipe
Non-destructive inspection	In accordance with Annex K (Amended)
CTOD test for pipe of all Grades	As per Annex B (Amended) of this specification..
Mill Qualification and First Day Production Test	Manufacturing Procedure Qualification test (MPQT) / First Day Production Test As per Annex B (Amended) of this specification.

J.8.2 Samples and test pieces for mechanical and technological tests.

SUBSTITUTE

J.8.2.1.1 For tensile tests, CVN impact tests, CTOD tests the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

J.8.2.1.2 Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in Table J.8 taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4 and J.8.2.2 of this specification.

Both transverse and longitudinal tensile test shall be carried out for each lot of 100 pipes or less, belonging to the same heat and manufactured by the same process. In case of pipe diameters i.e.



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219.1 mm (8-5/8 inches) and smaller, transverse tensile test is not required.

J.8.2.2 Test Pieces for CTOD tests

SUBSTITUTE

Test pieces shall be taken from the parent metal and shall be prepared in accordance with ISO 12135, ASTM E1290, or BS 7448. The sampling procedure and position of test piece notches shall be as agreed.

J.8.3 Test method

J.8.3.1 CTOD Test


SUBSTITUTE

CTOD testing shall be carried out in accordance with the requirements of BS 7448. One set of three specimens shall be taken in transverse direction. However, in case of pipe OD \leq 219.1 mm; specimen may be taken in longitudinal direction. The test shall be carried out at 0°C. Minimum acceptable critical CTOD value shall be 0.2 mm. Average CTOD value shall be reported.

J.8.3.2 Hardness test

J.8.3.2.1 SUBSTITUTE

Vickers hardness tests as per ASTM E-92 shall be carried out on samples of pipes at locations indicated in Figure J.1 a) to establish that the hardness of the pipe material is less than 250 HV10. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12 of this specification.

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Annex K (AMENDED)

Non-destructive inspection for pipe ordered for sour service and / or offshore service.

K2.1.3 (AMEND)

Ultrasonic inspection with automated/semi-automated systems in accordance with ISO 10893-8 or by manual methods, as specified in Annex A of ISO 10893-8 shall be used to verify that 100mm wide zone at each pipe end is free of laminar defects.

K2.1.4 (AMEND)

The end face/bevel at each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 10893-5 or ASTM E709. Laminar imperfections > 6.4 mm (0.25 in) in the circumferential direction shall be classified as defects.

Residual magnetism after MPI shall not exceed 20Gauss measured by Hall Effect Gauss Meter.

K.3.2.1 & K.3.2.2 (AMEND)

Acceptance criteria for laminar imperfections shall be as per table K.1 for service condition "Sour, if agreed". The coverage during automatic inspection shall be 100% of the pipe surface.

K.3.3 (AMEND)

The coverage during inspection shall be 100% of the pipe surface.

K.3.4 (AMEND)

K.3.4.1 (Amend): SMLS pipe shall be ultrasonically inspected for the detection of transverse imperfections in accordance with 10893-10 acceptance level U2/C, or ASTM E213.

AND

Either requirement of K3.4.2 (Amend) OR K3.4.3 (Amend)

K.3.4.2 (Amend)

SMLS pipe shall be full body inspected using the flux leakage method in accordance with ISO 10893-3 acceptance level F2, or ASTM E570 for the detection of both longitudinal and transverse imperfections.

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K3.4.3 (Amend)

SMLS pipe shall be full body inspected for the detection of imperfections using the eddy current method in accordance with ISO 10893-2 acceptance level E2H/E2, or ASTM E309.

K3.4.4 (Amend)

Full body magnetic particle inspection of SMLS pipes is NOT required.



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ADDENDUM TO FUNCTIONAL
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LINEPIPE FOR SUBMARINE
PIPELINES (NON SOUR
SERVICE)

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ADDENDUM TO FUNCTIONAL SPECIFICATION FOR CARBON STEEL SEAMLESS LINEPIPE FOR SUBMARINE PIPELINES (NON SOUR SERVICE)

Prepared By

CSR	RKP	SBD	TMK	SK	RP	NVP

Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
BPM	AKM	02	06.01.2021	0



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Sl. No.	Clause Reference, page no.	Existing provision in spec.	Modified Clause of Spec.																										
1	8.3.2 Amend Page no. 11 of 33	Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed. Steel shall be made by continuous casting only. Pipes shall be seamless construction. Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.	<p><i>Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed. Steel shall be made by continuous casting only.</i></p> <p><i>Steel shall be treated for inclusion shape control.</i></p> <p><i>Steel shall be sampled for inclusion content as per ASTM E-45 and tested for Inclusion Content by JK-type inclusion ratings procedure using automatic image analysis in accordance with microscopic Method -A of ASTM E-45 and reported as per ASTM E-45.</i></p> <p><i>Maximum limit of inclusion severity level in steel, as per ASTM E-45 Standard, method A, shall be as under:</i></p> <table><tr><th><i>Inclusion Type</i></th><th colspan="2"><i>Type A (Sulphide)</i></th><th colspan="2"><i>Type B (Alumina)</i></th><th colspan="2"><i>Type C (Silicate)</i></th><th colspan="2"><i>Type D (Globular Oxide)</i></th></tr><tr><th rowspan="2"><i>Severity Level</i></th><th><i>Thin</i></th><th><i>Heavy</i></th><th><i>Thin</i></th><th><i>Heavy</i></th><th><i>Thin</i></th><th><i>Heavy</i></th><th><i>Thin</i></th><th><i>Heavy</i></th></tr><tr><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td></tr></table> <p><i>Pipes shall be seamless construction. Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.</i></p>	<i>Inclusion Type</i>	<i>Type A (Sulphide)</i>		<i>Type B (Alumina)</i>		<i>Type C (Silicate)</i>		<i>Type D (Globular Oxide)</i>		<i>Severity Level</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0
<i>Inclusion Type</i>	<i>Type A (Sulphide)</i>		<i>Type B (Alumina)</i>		<i>Type C (Silicate)</i>		<i>Type D (Globular Oxide)</i>																						
<i>Severity Level</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>	<i>Thin</i>	<i>Heavy</i>																					
	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0																					



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**SPECIFICATION
FOR
CARBON STEEL SEAMLESS LINE PIPE
FOR
SUBMARINE PIPELINES
(SOUR SERVICE)**

**OIL AND NATURAL GAS CORPORATION LTD.
INDIA**

AVIN ASHOK EE(C)	R.P. PUROHIT SE(C&M)	SUDHIR KUMAR CE(C&M)	ROHIT PANT CE(M)	S.NARAIN Dy.G.M.(C&M)
R.K. GUPTA Dy.G.M.(C&M)	BALMIKI SINGH Dy.G.M.(C&M)	B.P.MALIK Dy.G.M.(C&M)	K.P.VARGHESE Dy.G.M.(C&M)	
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REVIEWED BY		APPROVED BY		
39	22.01.2015	5		
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SCOPE

This specification establishes the minimum requirements for the materials, fabrication, inspection, testing and supply of seamless carbon steel line pipe to be used for submarine pipelines and risers transporting sour hydrocarbons. Line pipes furnished in accordance with this specification shall meet the requirements of **API Specification 5L, Forty-Fifth Edition** and the **supplementary requirements stated herein.**

All carbon steel pipes made according to this specification shall be PSL2. All material shall be suitable for sour service and shall be in accordance with NACE MR-01-75 / ISO 15156.

This specification covers seamless line pipes of pipe diameters up to 406.4 mm OD (16 inches) and grades up to Grade L450 (X65). The Manufacturer shall have the license to use API monogram for manufacturing of pipes in accordance with the requirements of API Spec 5L, **Forty-Fifth Edition.**

“COMPANY” means “Oil and Natural Gas Corporation Ltd.”, wherever used in this specification.

NOTE

The sections, paragraphs contained herein have the same numbering as the sections and paragraphs of API 5L, in order to facilitate reference.

In this Specification, amendments to API 5L fall into the following Categories:

ADD	Where additions have been made to the API 5L clause or paragraph.
AMEND	Where the API 5L clause has been modified. Only the modified portions will be detailed in this Specification
DELETE	Where the complete clause or paragraph is to be disregarded.
SUBSTITUTE	Where the text has been substituted for the complete clause or paragraph in API 5L.

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6 PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe Grade and Steel Grade

6.1.2 ADD

Maximum pipe grade shall be up to Grade L450 (X65), where 450 represents the Yield Strength in MPa.

6.2 Delivery Condition

6.2.2 ADD

The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.


7 INFORMATION TO BE SUPPLIED BY THE PURCHASER

7.1 General Information

The purchase order shall include the following information:

SUBSTITUTE

Sl. no	Information to be provided as per API 5L	Information provided by the COMPANY to be incorporated in PO/PS.
a)	quantity(e.g. total mass or total length of pipe)	As per provisions of the Contract.
b)	PSL (1 or 2)	PSL2
c)	type of pipe (see Table 2)	Seamless
d)	reference to API 5L	API Spec 5L, Forty-Fifth Edition
e)	steel grade (see 6.1, H.4.1.1 or J.4.1.1, whichever is applicable)	Refer Table 5 (Substituted) of this Specification for all the standard grades up to L450 (X65)
f)	outside diameter and wall thickness (see 9.11.1.2)	As per provisions of the Purchase Specification
g)	length and type of length random or approximate) (see 9.11.1.3, 9.11.3.3 and Table 12)	Refer J.6.3 of API 5L of Forty-Fifth Edition
h)	confirmation of applicability of individual annexes.	The applicable Annexes as shown in the following supplementary Table:

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Applicable Annexures:

Annex.	Service
Annex B (Substituted) -Manufacturing procedure qualification for PSL 2 pipe	Offshore and Sour Service both.
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore and Sour Service both.
Annex H (Amended) - PSL 2 Pipe ordered for Sour Service	Offshore and Sour Service both.
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore and Sour Service both.
Annex K (Amended) - Non-destructive inspection for pipe ordered for sour service and/or offshore service	Offshore and Sour Service both.

7.2 ADDITIONAL INFORMATION

SUBSTITUTE

a)	Items that are subject to mandatory agreement, if applicable:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	pipe designation for intermediate grades [see Table 1, footnote a)]	Not applicable
2	chemical composition for intermediate grades (see 9.2.1 and 9.2.2)	Not applicable
3	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see 9.2.3)	Refer 9.2.3 and Table 5 (substituted) along with its footnotes of this specification.
4	carbon equivalent limits for PSL 2 pipe in Grade L415N or X60N (see Table 5)	Refer 9.2.4 & 9.2.5 of this specification.
5	carbon equivalent limits for PSL 2 pipe in Grade L555Q or X80Q, L625Q or X90Q, and L690Q or X100Q (see Table 5),	Not applicable
6	carbon equivalent limits for PSL 2 SMLS pipe with $t > 20,0$ mm (0.787 in) [see Table 5, footnote a)],	Refer 9.2.4 & 9.2.5 of this specification.

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7	diameter and out-of-roundness tolerances for pipe with $D > 1422$ mm (56.000 in) (see Table 10)	Not applicable
8	diameter and out-of-roundness tolerances for the ends of SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table 10, footnote b)]	Table 10 is not applicable. Refer J.6.1 of this specification.
9	standard applicable to jointer welds (see A.1.2)	Not applicable. Joints are not permitted.

b)	Items that apply as prescribed, unless otherwise agreed:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	range of sizing ratio for cold-expanded pipe (see 8.9.2)	Not applicable.
2	equation for sizing ratio (see 8.9.3)	Not applicable.
3	chemical composition limits for PSL 1 pipe [see Table 4, footnotes c), e) and f)]	Not applicable.
4	chemical composition limits for PSL 2 pipe [see Table 5, footnotes c), e), f), g), h), i), k), and l)],	Refer Table 5 (substituted) along with its footnotes of this specification.
5	yield/tensile ratio for grades L625Q or X90Q, L690 or X100 and L830 or X120 [see Table 7, footnotes g and h or Table J.2, footnotes h and i],	Not applicable
6	estimation and reporting of Charpy shear area (see 9.8.2.3)	Not applicable
7	tolerances for random length pipe [see 9.11.3.3 a)]	Refer 9.11.3.3 of this specification. Table 12 of API 5L shall not be applicable.
8	type of thread compound (see 9.12.2.4)	Not applicable
9	type of end face (see 9.12.5.1 or 9.12.5.2)	Section 9.12.5.2 of API 5L shall be applicable.
10	International Standard applicable to Charpy testing (see 10.2.3.3, 10.2.4.3, D.2.3.4.2 and D.2.3.4.3)	Charpy V- notch testing shall be done in accordance with ASTM A370.

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11	product analysis method (see 10.2.4.1),	As per Section 10.2.4.1 of API 5L
12	alternate method for diameter measurement for $D \geq 508$ mm (20.000 in) (see 10.2.8.1),	Not Applicable
13	jointer welding type (see A.1.1),	Not applicable
14	offset of longitudinal pipe weld seams at jointer welds (see A.2.4)	Not applicable
15	repairs in cold-expanded pipe (see C.4.2)	Not applicable.
16	alternate IQI type (see E.4.3.1);	Not applicable.

c) Items that apply, if agreed:		
Sl. no.	Information to be provided as per API 5L	Information by ONGC to be incorporated in PO/PS.
1	delivery condition (see 6.2 and Table 1)	PSL 1 shall not be applicable. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.
2	supply of quenched and tempered PSL 1 Grade L245 or B SMLS pipe (see Table 1),	Not applicable.
3	supply of intermediate grades [see Table 2, footnote a)]	Not applicable.
4	supply of double-seam SAWL pipe [see Table 2, footnote c)]	Not applicable.
5	alternative to specified seam heat treatment for PSL 1 pipe (see 8.8.1)	Not applicable.
6	supply of SAWH pipe with coil/plate end welds at the pipe ends (see 8.10.3),	Not applicable.
7	supply of jointers (see 8.11)	Not applicable .Jointers are not permitted
8	CVN impact test temperature lower than 0°C (32°F) (see 9.8.2.1, 9.8.2.2 and 9.8.3)	CVN impact test temperature lower than 0°C (32°F) is not applicable.
9	CVN impact test of the pipe body of PSL 2 welded pipe with $D < 508$ mm (20.000 in) for shear fracture area (see 9.8.2.2 and Table 18)	Not applicable.



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10	CVN impact test of the longitudinal seam weld of PSL 2 HFW pipe (see 9.8.3 and Table 18)	Not applicable.
11	DWT test of the pipe body of PSL 2 welded pipe with $D \geq 508$ mm (20.000 in) (see 9.9.1 and Table 18)	Not applicable.
12	DWT test temperature lower than 0°C (32°F) (see 9.9.1)	Not applicable.
13	fraction jointers comprising 2 or 3 pieces for 12 m (40 ft) nominal or 24 m (80 ft) nominal, respectively [see 9.11.3.3.c), d), and e)],	Not applicable.
14	power-tight make-up of couplings (see 9.12.2.3 and 10.2.6.1)	Not applicable.
15	special bevel configuration (see 9.12.5.3)	Not applicable.
16	removal of outside weld bead at pipe ends of SAW or COW pipe [see 9.13.2.2 e)]	Not applicable.
17	weldability data or tests for PSL 2 pipe (see 9.15)	Weldability data shall be provided. Refer Table 5(Substituted) read with 9.2.4(Substituted) /9.2.5(Substituted) of this Spec. For X65 Grade pipes, in addition to above requirements, weldability tests shall also be carried out.
18	type of inspection document for PSL 1 pipe (see 10.1.2.1)	Not applicable.
19	manufacturing information for PSL 1 pipe (see 10.1.2.2)	Not applicable.
20	alternative type of inspection document for PSL 2 pipe (see 10.1.3.1)	Refer 10.1.3.1 (Amended) of this Specification.
21	use of transverse test pieces for tensile tests of SMLS pipe, not cold-expanded [see Table 20, footnote c)]	<ul style="list-style-type: none"> For pipe OD > 219.1mm both transverse and longitudinal tensile test shall be carried out for each lot of 100 pipes or less, belonging to the same heat and manufactured by the same process.

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		<ul style="list-style-type: none"> For pipe OD $\leq 219.1\text{mm}$ the test shall be carried out in longitudinal direction only; however longitudinal tensile testing frequency shall be as per this specification.
22	use of the ring expansion test for transverse yield strength determinations [see 10.2.3.2, Table 19 note c), and Table 20 note d)],	Not Applicable.
23	use of an alternative to macrographic examination (see 10.2.5.2)	Not applicable
24	hardness test during production of EW and LW pipe (see 10.2.5.3)	Not applicable
25	specific condition to be used for hydrostatic tests for threaded and coupled pipe (see 10.2.6.1)	Not applicable
26	alternate hydro test pressure (see Table 26),	Not Applicable. Refer 10.2.6 (Substituted) of this specification.
27	use of minimum permissible wall thickness to determine hydrostatic test pressure (see 10.2.6.7)	Applicable.
28	specific method to be used for determining pipe diameter (see 10.2.8.1)	Clause 10.2.8.1 is Applicable. Further, Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 (Substituted) of this specification.
29	use of inside diameter measurements to determine diameter and out-of-roundness for expanded pipe with $D \geq 219,1 \text{ mm}$ (8.625 in) and for non-expanded pipe [see 10.2.8.3 and Table 10, footnote c)].	Acceptable. Refer Cl. J.6.1 (Substituted) of this Specification) and Cl.10.2.8.3 of API 5L, 45th Edition).
30	specific method to be used for determining other pipe dimensions (see 10.2.8.7)	Proposed methods shall be subject to COMPANY approval.
31	paint-stencilled markings for couplings (see 11.1.2)	Not applicable

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32	additional markings specified by the purchaser (see 11.1.4)	For segregation of pipes additional markings/colour bands may be decided by the LSTK contractors.
33	specific surface or location for pipe markings [see 11.2.2 b) and 11.2.6 b)]	Applicable.
34	die-stamping or vibro-etching of pipe (see 11.2.3)	Only low stress die stamping shall be permitted on the pipe bevel face preferably at the opposite end to pipe stencilled markings. The low stress marking shall be the unique pipe number only. Cold die stamping is not permitted on the pipe body. In case low stress die-stamping on bevel face is technically not feasible, alternate measures shall be made for providing unique pipe number for ensuring traceability of pipes.
35	alternative location for marking the pipe (see 11.2.4)	Marking shall be carried out at the pipe mill. Further, for pipes intended for subsequent coating, LSTK contractor shall submit the procedure for marking at coating yard ensuring the traceability of pipes.
36	alternative format for pipe length marking locations (see 11.2.6a),	Not applicable.
37	colour identification for pipe (see 11.2.7)	As per 11.2.7 of API 5L.
38	multiple grade marking (see 11.4.1),	Not applicable.
39	temporary external coating (see 12.1.2)	Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.
40	special coating (see 12.1.3)	Not applicable
41	lining (see 12.1.4),	Not applicable




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42	manufacturing procedure qualification for PSL 2 pipe, in which case, Annex B shall apply (see B.2),	Refer Annex B (Substituted) of this specification.
43	radiographic inspection of SAW seam or coil/plate end seam (see Table E.1)	Not applicable
44	non-destructive inspection of PSL 1 SMLS pipe (see E.3.1.2),	Not applicable
45	NDT of EW seam welds after hydrotest [see E.3.1.3 b)],	Not applicable
46	ultrasonic inspection of welded pipe for laminar imperfections at pipe ends (see E.3.2.3)	Not applicable
47	ultrasonic inspection of SMLS pipe for laminar imperfections at pipe ends (see E.3.3.2)	Refer Annex.K (Amended) of this Spec.
48	radiographic inspection in accordance with Clause E.4,	Not applicable
49	use of both holes and notches in ultrasonic reference standard (see Table E.7),	Acceptable
50	alternative re-inspection technique for COW seams (see E.5.5.5)	Not applicable
51	ultrasonic inspection for laminar imperfections in the pipe body of EW, SAW or COW pipe (see Clause E.8)	Not applicable
52	ultrasonic inspection for laminar imperfections along the coil/plate edges or the weld seam of EW, SAW or COW pipe (see Clause E.9)	Not applicable
53	supply of welded couplings on pipe with $D \geq 355,6$ mm (14.000 in) (see F.1.4)	Not applicable
54	application of Annex G to PSL 2 pipe where purchaser shall specify the toughness test temperature, the minimum energy for each test and the minimum average energy value required for the order (see G.2),	Refer 9.8.2.1 (Amended) of this specification
55	PSL 2 pipe for sour service, in which case, Annex H shall apply (see H.2),	Refer Annex H (Amended) of this specification.
56	TFL pipe, in which case, Annex I shall apply (see I.2),	Not applicable

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57	pipe for offshore service, in which case, Annex J shall apply (see J.2),	Refer Annex J (Amended) of this specification
58	any other additional or more stringent requirements.	As included within this document.

8 MANUFACTURING

8.1 Process of Manufacture

ADD

This specification is applicable for seamless pipe only. Other types of pipes specified in Table 2 and pipe for intermediate grades (refer footnote a) of Table 2 are not applicable in this specification. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.

8.3 Starting Material

8.3.2 AMEND

Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced (blistering and stepwise) cracking.

Steel shall be made by continuous casting only. Pipes shall be seamless construction. Manufacturing procedure as mentioned in Annex B (Substituted) of this specification shall be prepared and submitted to Company for approval prior to start of production.

8.3.3 ADD

The steel shall be fully killed and made with fine grain structure with a grain size of ASTM 7 or finer as per ASTM E 112.

8.9 Cold Sizing and cold expansion

SUBSTITUTE

Cold expansion shall not be permitted for seamless pipes.

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8.11 Jointers

AMEND

Jointers shall not be permitted.

8.12 Heat Treatment

ADD

The pipes shall be “normalized” or “ normalized and tempered” or “quenched and tempered”. Other types of heat treatment shall be agreed upon between the COMPANY and Manufacturer. Temperature of furnace shall be controlled and recorded and such records shall be accessible to Company.

9 ACCEPTANCE CRITERIA

9.2 Chemical Composition

9.2.2 & 9.2.3

AMEND

The chemical composition of each heat of steel on product analysis for all the standard grades up to L450 (X65) shall be in accordance with Table-5 (substituted) given below. Intermediate grades are not permitted.

TABLE 5 (SUBSTITUTED)

API 5L Table-5 including its notes is substituted as under:

C max. %	0.14
Mn max. %	1.55
Si max. %	0.45
P max. %	0.015
S max. %	0.003
Cr max. %	0.3
Ni max %	0.3
Al _{total} max. %	0.06
N max. %	0.01
Cu max %	0.35
Mo max. %	0.10
B max. %	0.0005
Nb max. %	0.05
Ti max. %	0.07
V max. %	0.09



NOTES :

- i) V + Nb + Ti shall not exceed 0.12%
- ii) For steel grade L245 NS & L245 NO, V + Nb shall not exceed 0.06%.
- ii) Cu + Ni shall not exceed 0.50 %.
- iii) Al/N ratio shall be minimum 2.0 (Not applicable to Titanium killed steel)
- iv) Ca concentration shall be ≤ 0.006 %.
- v) For steels with carbon content $\leq 0.12\%$, the PCM value based on product analysis shall not exceed 0.21, when calculated using the formula given in 9.2.4.
- vi) For steel with carbon content $> 0.12\%$, the CE value based on product analysis shall not exceed 0.40, when calculated using the formula given in 9.2.5.
- vii) If alloying elements other than those specified in Table 5 (Substituted) are added to the steel, limits of the additional components shall be agreed with the Company.

9.2.4 SUBSTITUTE

For steels with carbon content $\leq 0.12\%$, the PCM value based on product analysis shall not exceed 0.21, when calculated using the formula given below:

$$CE_{Pcm} = C + \frac{Ni}{60} + \frac{Si}{30} + \frac{Mn+Cu+Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

9.2.5 SUBSTITUTE


For steel with carbon content $> 0.12\%$, the Carbon Equivalent (CE) based on product analysis shall be less than or equal to 0.40, when calculated using the formula given below:

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

9.3 Tensile Properties

9.3.2 SUBSTITUTE

The minimum Yield strength, minimum Tensile strength and minimum % elongation of finished pipes (after all heat treatment and sizing operations) shall conform to the requirements of Table J.2 of API 5L. However, other requirements of Table J.2 are not applicable.

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The actual yield strength shall be as close as possible to the specified minimum yield strength but in no case it shall be more than 133% of the specified minimum yield strength.

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

9.4 Hydrostatic Tests

9.4.1 SUBSTITUTE

The test pressure shall be held for a minimum period of 10 seconds for all sizes and grades of pipes.

9.8 CVN Impact Test for PSL 2 Pipe

9.8.1 General ADD

The Manufacturer shall perform the Charpy V-notch tests in accordance with the latest edition of ASTM A 370 using absorbed energy criteria and the requirements mentioned herein.

Flattening of specimens shall not be permitted. Specimens shall be taken in a transverse direction. When it is not feasible to secure even half-size specimens in transverse direction because of pipe size or wall thickness, test specimens shall be taken in a longitudinal direction to pipe axis. The energy requirements for longitudinal specimens shall be 1.5 times those of transverse specimens as detailed in 9.8.2.1(Amended) of this specification.

In addition, CTOD tests shall be carried out as per the requirement of the first day production tests. Refer Annex B (Substituted).

9.8.1.3 AMEND


Tests shall be conducted at 0°C (32°F)

9.8.2 Pipe Body Tests

9.8.2.1 AMEND

The minimum average absorbed energy and minimum individual absorbed energy for each pipe body test shall be 41 J and 31J respectively in the transverse direction for a set of three test pieces based upon full-size test pieces and a test temperature of 0 °C (32 °F). Test temperature lower than 0°C (32°F) is not applicable.

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9.10 Surface Conditions, Imperfections and Defects

9.10.4 Laminations

ADD

Refer Annex K (Amended).

9.10.5 Geometric Deviations

9.10.5.2 AMEND

Depth of dent shall not exceed 2 mm and length in any direction shall not exceed half of the pipe diameter, provided this dent does not give rise to a hard spot at the internal surface exceeding 250 HV10. Disposition of dents shall be carried out in accordance with API 5L para C.3.b) or C.3.c) of Annex C.

9.10.6 Hard Spots

SUBSTITUTE

Any hard spot larger than 50 mm (2.0 in) in any direction shall be classified as a defect if its hardness exceeds 250 HV10 based upon individual indentations. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C(Amended).


9.10.7 Other Surface Imperfections

SUBSTITUTE

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

- Imperfections that have a depth $\leq 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1.
- Imperfections that have a depth $> 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as defects and shall be dressed –out by grinding in accordance with Clause C.2 (Amended) or shall be treated in accordance with Clause C.3.
- Imperfections that encroach on the minimum permissible wall thickness shall be classified as defects and shall be treated in accordance with Clause C.3.

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9.11 Dimensions, Mass and Tolerances

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

AMEND

Tables 10, 11 & 12 of API 5L shall not be applicable.

9.11.3.1 SUBSTITUTE

Tolerances for diameter and out-of-roundness shall be as per J.6.1 (Substituted) of this specification.

9.11.3.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table 11 shall not be applicable.

9.11.3.3 Refer J.6.3 of API 5L

9.11.3.4 SUBSTITUTE

The tolerances for straightness shall be as per J.6.4 of API Specification 5L

10 INSPECTION

10.1.3. Inspection documents for PSL 2 pipe

10.1.3.1 AMEND


Inspection certificate shall be issued and validated as per “3.1C” in accordance with ISO 10474 : 1991.

10.1.3.2 SUBSTITUTE

The manufacturer shall provide production report including acceptance test certificates as mentioned in 13 of API Specification 5L (as applicable for seamless pipe) in six copies, which shall include the results of all testing required as per this specification and performed on raw material and delivered pipes giving details of, but not limited to the following for each pipe length:

- COMPANY's Name and Order Number;
- SUPPLIER's Identification;

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- Name and location of facilities used for pipe manufacturing and steelmaking
- Pipe specified outside diameter, specified wall thickness, pipe grade
- Product Specification Level (PSL) and delivery condition;
- Steelmaking Process;
- Identification of Steel Type and Grade;
- Billet number, as applicable;
- Certificates of Product and Ladle Analysis;
- CE_{IIW} & Pcm for both Product and Ladle Analysis;
- Pipe Identification number, Heat number, Pipe length and Pipe weight
- Certified measurements for Dimensional measurements/ tolerance
- Mechanical Test Certificates, including hardness surveys;
- Yield/Tensile Ratio (based on R_{10.5});
- Pipe Elongation;
- Charpy Impact Results;
- Hardness Tests;
- Heat Treatment Condition
- Hydrostatic Test Certificate, or statement;
- NDT Procedures and Results;
- Surface Inspection;
- Dimensional Control Checks;
- Manufacturing Procedure Specification and Qualification Tests;
- HIC, including photomicrographs ; Four Point Bend Test , Hardness test and CTOD test records;
- Information on production & shipping
- All other reports and results as required as per this specification
- NDT Operator Qualification Certificates;
- Inspection certificate issued and validated by Authorized representative of Purchaser, as per “3.1C” of ISO 10474 : 1991, in accordance with this specification.
- COMPANY Authorized representative's Pipe Inspection and Release Note.

Such documents shall indicate pipe identification number, the origin of each individual test specimen etc. and shall be written in English only. International system of units (SI) shall be adopted. The certificates shall be valid only when signed by Company Representative. Only those pipes which have been certified by Company Representative shall be dispatched from the pipe mill.

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Manufacturer shall also provide information on test failure / rejected heats etc.

10.2 Specific Inspection

10.2.1 Inspection frequency

10.2.1.2 AMEND

For PSL 2 pipe, the inspection frequency shall be as given in Table 18 with following amendments:

Table 18 (Amended)

Type of Inspection	Frequency of inspection
Product Analysis	Two pipes per heat of steel shall be analyzed for all elements listed in Table-5 (substituted). When more than 100 pipes are manufactured from one heat, additional product analysis for one pipe shall be carried out for every 100 pipes or less of the same heat.
Tensile testing of the pipe body	A transverse and longitudinal tensile test once per test unit of not more than 100 lengths of the pipe. In case of pipe diameters 219.1 mm (8-5/8 inches) and smaller, only longitudinal tensile test shall be carried out.
CVN impact testing of the pipe body of pipe with specified outside diameter and specified wall thickness as given in Table 22.	Once per test unit of not more than 100 lengths of the pipe.
Pipe diameter and out-of-roundness for pipe with $D \leq 168,3$ mm (6.625 in)	At pipe ends, pipe diameter and out of roundness will be checked 100% by properly sized go-no go gauge/ caliper for verification of dimensions within tolerances as per Company's spec. However measurement frequency shall be once per test unit of not more than 100 lengths of pipe.
Pipe diameter and out-of-roundness for pipe with $D > 168,3$ mm (6.625 in)	At pipe ends, pipe diameter and out of roundness will be checked 100% by properly sized go-no go gauge/ caliper for verification of dimensions within tolerances as per Company's spec. Once per test unit of not more than 20 lengths of pipe
Non-destructive inspection	In accordance with Annex K (Modified)



CTOD test for seamless pipe of all Grades	As per Annex B (substituted).
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10.2.3 Samples and test pieces for mechanical tests.

SUBSTITUTE

- 10.2.3.1** For tensile tests, CVN impact tests and CTOD tests, the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in J.8 of this specification, taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4. and J.8.2.2.

10.2.6 Hydrostatic Test

10.2.6.1 SUBSTITUTE

The test pressure for all sizes and grades of pipes shall not be less than the maximum pressure calculated based on either of the criteria mentioned at 10.2.6.5 (amended) and 10.2.6.6 (amended) .The test pressure shall be held for a minimum period of 10 seconds for all sizes and grades of pipes.

10.2.6.5 AMEND


The required test pressure shall produce a hoop stress of at least 90% of the specified minimum yield strength for all the grades and sizes.

10.2.6.6 AMEND

In case, pressure testing involves end sealing ram, the required test pressure shall produce a hoop stress of at least 95% of the specified minimum yield strength for all the grades and size.

10.2.7 Dimensional testing

10.2.8.1 ADD

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Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 (Substituted) of this **specification**.

10.2.10 SUBSTITUTE

Non-destructive inspections shall be in accordance with Annex K modified.

10.2.11 SUBSTITUTE

Reprocessing is not permitted.

10.2.12 Retesting (SUBSTITUTE)

10.2.12.1 Recheck Analysis

If any parts of the full product analysis on any one of the fully analyzed pipes fail to meet the requirements of H.4.1 of this specification, either the whole heat shall stand rejected or each individual pipe shall be fully analyzed and all pipes failing to meet the requirements of H.4.1 of this specification shall be rejected.

10.2.12.2 Tensile retest and Charpy retest

In case one of the test specimens fails to conform to the specified requirements, a retest on four additional pipes from the same lot shall be made. If all re-tests give positive result, then the pipe, which gave the negative result, shall be rejected and the balance lot shall be accepted.

In case of negative result of one of the re-test specimens, the lot may be rejected or each of the remaining lengths shall be tested individually. The pipes, which give results as per requirement of this specification, shall only be accepted.

11.2 Pipe markings

11.2.1 ADD

Marking shall be in English using SI units. Markings shall also include API monogram, purchase order number, item number, heat number, wall thickness (mm), pipe number, weight and grade. Weight marked shall be the actual weight of the pipe. All pipes shall be marked with API monogram.

11.2.7 AMEND

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Manufacturer shall apply a daub of approx. 50mm in diameter on inside surface of each length of pipe. The paint colour shall be as given in Table 27.

13 Retention of Records

ADD

In addition to the records indicated in clause 13, the manufacturer shall retain the records of all additional tests mentioned in this specification including the ultrasonic testing carried out on pipe as well as pipe ends.

ANNEXES OF API 5L (Substituted/ Amended)

Annex B - Manufacturing procedure qualification for PSL 2 pipe	Refer Annex B (Substituted) of this Specification.
Annex C - Treatment of surface imperfections and defects	Refer Annex C (Amended) of this Specification.
Annex H-PSL 2 Pipe ordered for Sour Service	Refer Annex H (Amended) of this Specification.
Annex J - PSL 2 pipe ordered for offshore service	Refer Annex J (Amended) of this Specification.
Annex K - Non-destructive inspection for pipe ordered for sour service and/or offshore service	Refer Annex K (Amended) of this Specification.



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Annex B (SUBSTITUTED)

Manufacturing Procedure Qualification for PSL 2 Pipe

Mill Qualification and First Day Production Test

Mill Qualification Tests

Prior to start of regular production, the following tests shall be carried out, in order to qualify the Mill for regular production of pipes.

Sulphide Stress Cracking Test.

Manufacturer shall carry out NACE standard tensile test (Method A) for Sulphide Stress Cracking Test in accordance with NACE standard TM-0177: 2005 using test solution A. The test shall be carried out at 60,72,80,90 and 100% SMYS stress levels to produce a curve. Minimum stress for failure after 720 hours shall be at least 72% of SMYS.

Hydrogen Induced Cracking Test.

The HIC test shall be carried out in accordance with NACE standard TM-0284, "Test Method of Pipeline Steel for Resistance to Stepwise Cracking" and as specified in H.7.3.1.1 of this specification. The acceptance criteria for crack sensitivity ratio (CSR) shall be 0.00%.

Four Point Bend Test

Manufacturer shall carry out Four Point Bend Test using NACE solution as specified in H.7.3.2.1 of this specification. The acceptance criteria shall be that the specimen shall not have any SSC cracks when examined visually as well as with wet magnetic particle method. Mills shall be considered qualified only subsequent to successful completion of all the tests as mentioned above. Requirement of these tests may be waived by mutual agreement between Company and the Manufacturer in case Manufacturer possess records of successful performance of this test on a previous supply of line pipes produced by the same method of manufacture, similar chemical composition and grade of steel and subjected to similar heat treatment provided such tests had been performed not earlier than two years prior to this enquiry. Such test certificates duly witnessed and approved by an internationally reputed independent

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Inspection Agency along with a description of the tests performed shall be furnished by the Manufacturer in case Manufacturer desires a waiver of this test.

FIRST DAY PRODUCTION TESTS

Two lengths of finished pipes (in case of only one heat on first day) or two lengths from the first two heats i.e. one pipe from each heat (in case of more than one heat on first day) of first day's production shall be selected at random for testing to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The first day production tests shall be carried out on pipes of maximum diameter and minimum wall thickness. The pipes thus tested shall be considered to be the test pipes required per heat or per lot as required in the relevant paragraphs of this specification.

These first day's production tests shall be repeated upon any change in the manufacturing procedure or any change in the source of raw materials as deemed necessary by Company's Representative.

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

The various tests to be conducted on each pipe shall be as follows.

a) Visual Examination


All pipes shall be examined visually for dimensional tolerances and apparent surface defects in accordance with 9,10 & 11 respectively of this specification.

b) Mechanical Properties

The mechanical properties of all pipes shall be tested and shall meet the requirements of the relevant sections of this specification.
The following tests shall be conducted:

- i) Tensile tests shall be conducted on two transverse and two longitudinal base material specimens.
- ii) At points selected by Company's Representative, three impact test specimens shall be removed from the base material. Specimens shall be tested at 0°C

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iii) Hardness tests shall be carried out on selected pipes as per requirement of H.4.4 this specification.

c) CTOD testing shall be carried out in accordance with the requirements of BS 7448. One set of three specimens shall be taken in transverse direction. The test shall be carried out at 0°C. Minimum acceptable critical CTOD value shall be 0.2 mm. Average CTOD value shall be reported. For Pipe size $\leq 219.1\text{mm}$, longitudinal specimens for CTOD test are acceptable.

In addition all the data on fatigue pre-cracking front are required. (Crack length at the following positions i.e. both surfaces, 25%, 50% and 75% of the specimen thickness, the minimum and the maximum angle between the crack and the plane of the notch).

d) **Corrosion Tests**

i) HIC test shall be carried out as per H.7.3.1.1 of this specification.

ii) Four point bend test shall be carried out as per clause H.7.3.2.1 of this specification.

e) In addition, all the tests and inspection required to be conducted on each pipe as per this specification shall be conducted on all the pipes selected for testing during first day production test.

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Annex C (AMENDED)

C.2 Treatment of surface imperfections and defects

- C.2.3** Complete removal of defects shall be verified by local visual inspection, aided, where necessary, by suitable non-destructive inspection methods. To be acceptable, the diameter, out of roundness and wall thickness in the ground area shall be in accordance with 9.11.3.1 and 9.11.3.2 of this specification; further, the sum of all ground areas for surface defect treatment shall not exceed 10% of total internal and external surface area of each pipe.

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Annex H (AMENDED)

PSL 2 pipe ordered for sour service

H.2 Additional information to be supplied by the purchaser

Information Requirement

	Information sought as per API 5L	COMPANY's Requirement
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see H.3.3.2.1)	Not applicable
b)	ultrasonic inspection of strip or plate for laminar imperfections (see H.3.3.2.4)	Not applicable
c)	supply of helical-seam pipe containing coil/plate end welds (see H.3.3.2.5)	Not applicable
d)	chemical composition for intermediate grades (see H.4.1.1)	Not applicable
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see H.4.1.2)	Refer Table 5 (substituted) with foot notes thereof.
f)	chemical composition limits [see Table H.1, footnotes c), d), e), f), i), j) and k)]	Refer Table 5 (substituted) with foot notes thereof.
g)	frequency of hardness testing of the longitudinal seam weld of HFW or SAW pipe (see Table H.3)	Not applicable
h)	SSC test for manufacturing procedure qualification (see Table H.3)	SSC test is required in accordance with Annex B (substituted) of this specification.
i)	alternative HIC/SWC test methods and associated acceptance criteria (see H.7.3.1.3)	Acceptance criteria shall be as per H.4.3 of this specification.
j)	photomicrographs of reportable HIC cracks (see H.7.3.1.4)	Photomicrographs of all the HIC test pieces shall be provided.
k)	alternative SSC test methods and associated acceptance criteria for manufacturing procedure qualification (see H.7.3.2.2)	SSC test is required in accordance with Annex B (substituted) of this specification. Alternate SSC



		test methods are not acceptable.
l)	deviation from hardness test (see H.7.3.3.2 and H.7.3.3.3);	Not applicable
m)	deviation from 4 hardness impressions [see H.7.3.3.2 c)];	Not applicable
n)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3)	Required
o)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Required
p)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4)	Required
q)	verification of lamination size/density (see K.3.2.2);	Required
r)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3)	Coverage shall be as per K.3.3 (amended) plus 100mm at each pipe end.
s)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4)	UT in accordance with K.3.4.1 (amended).
t)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	UT in accordance with K.3.4.1 (amended).
u)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Required
v)	full-body inspection of SMLS pipe by the eddy current method (see K.3.4.3);	Required
w)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Required
x)	limitation of individual lamination size to 100 mm ² (0.16 in ²) (see Table K.1)	Required
y)	acceptance level U2/U2H for nondestructive inspection of the weld seam of HFW pipe (see K.4.1)	Not Applicable
z)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not Applicable
aa)	ultrasonic inspection of the pipe body of	Not Applicable



	HFW pipe for laminar imperfections (see K.4.2)	
bb)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3)	Not Applicable
cc)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux leakage method (see K.4.4)	Not Applicable
dd)	use of fixed depth notches for equipment standardization [see K.5.1.1 c)]	Not Applicable
ee)	radiographic inspection of pipe ends (non-inspected ends) and repaired areas [see K.5.3 a)]	Not Applicable
ff)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4)	Not Applicable

H.3 Manufacturing

H.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Substituted).

H.3.3 Pipe manufacturing

H.3.3.1 SUBSTITUTE

Steel shall be made by continuous casting only. Seamless pipes shall be non-expanded.


H.3.3.2 Not applicable

H.3.3.3 Jointers

SUBSTITUTE

Jointers are not permitted

H.4 ACCEPTANCE CRITERIA

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H.4.1 Chemical composition

SUBSTITUTE

Refer 9.2 [Table 5 (substituted)] with foot notes thereof.

Table H.1 SUBSTITUTE

Refer Table 5 (substituted) with foot notes thereof.

H.4.2 Tensile properties

H.4.2.1 SUBSTITUTE

The minimum Yield strength, minimum Tensile strength and minimum % elongation of finished pipes (after all heat treatment and sizing operations) shall conform to the requirements of Table J.2 of API 5L. However, other requirements of Table J.2 are not applicable.

The actual yield strength shall be as close as possible to the specified minimum yield strength but in no case it shall be more than 133% of the specified minimum yield strength.

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

H.4.3 HIC/SWC TEST

AMENDED

The acceptance criteria for crack sensitivity ratio (CSR) shall be 0.00%.

H.4.4 Hardness test

SUBSTITUTE

Vickers hardness tests as per ASTM E-92 shall be carried out on samples of pipes at locations indicated in Figure H.1 a) to establish that the hardness of the pipe material is less than 250 HV10. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12 of this specification.

H.7 Inspection

H.7.1 Specific inspection

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SUBSTITUTE

The frequency of inspection shall be as given in 10.2.1.2, supplemented with the requirements of Table H.3 with following amendments:

Type of Inspection	Frequency of inspection
Hardness testing	Test shall be carried out for each lot of 100 pipes or less.
SSC test (mill qualification test)	Refer Annex B (Substituted)
Four Point Bend Test	One test for each of the first three heats applied; thereafter, one test for each test unit of not more than ten heats of steel.

H.7.3 Test method

H.7.3.2 SSC test

H.7.3.2.1 SUBSTITUTE

SSC tests shall be performed in accordance with NACE TM0177:2005, using test Solution A.

SSC test for mill qualification of 720 hrs test duration shall be in accordance with Annex B (Substituted).

Four Point Bend Test

Four point bend test specimen preparation and size shall be as per ASTM G 39 except that thickness shall be minimum 5 mm. One set of three specimens shall be machined from the middle of the pipe wall thickness. The specimen shall be machined transverse to pipe axis. However, if the pipe diameter and / or wall thickness is such that the transverse specimen cannot be obtained, the specimen is to be taken in longitudinal direction. The specimens shall be bent using Four point Loading jigs to reach a stress level of 72% SMYS and then immersed in NACE solution as per NACE standard TM-0177 for a period of 96 hours with the inner surface in tension. Testing sequence shall be in accordance with NACE TM 0177. The acceptance criteria shall be that the specimen shall not have any SSC cracks when examined visually as well as with wet magnetic particle technique. Four point bend test shall be carried out on one pipe from each of the first three heats and then on one pipe from every ten subsequent heats. The selection of



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the specific sample heat out of every ten heats shall be as per the decision of Company Representative.

If one specimen fails to meet the criteria, the retest and acceptance procedure shall be as mentioned in H.7.3.1.1 above.

H.7.3.2.2 DELETED

H.7.3.3 Hardness test

H.7.3.3.1 SUBSTITUTE

Hardness testing shall be performed using the Vickers test in accordance with ISO 6507-1 or ASTM E 384.

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Annex J (AMENDED)

PSL 2 pipe ordered for offshore service

J.2 Additional information to be supplied by the purchaser

Information Requirement

	Information sought by API 5L	COMPANY's Requirement
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see J.3.3.2.1)	Not applicable
b)	ultrasonic inspection of strip or plate for laminar imperfections (see J.3.3.2.4)	Not applicable
c)	supply of helical-seam pipe containing coil/plate end welds (see J.3.3.2.5)	Not applicable
d)	chemical composition for intermediate grades (see J.4.1.1)	Not applicable
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see J.4.1.2)	Refer Table 5 (substituted) with foot notes thereof.
f)	carbon equivalent limit for steel Grade L555QO or X80QO, L625QO or X90QO, and L690QO or X100QO (see Table J.1);	Not applicable
g)	Chemical composition limits [see Table J.1, footnote d]	Refer Table 5 (substituted) with foot notes thereof.
h)	Acceptance criteria for tensile properties if determined at other than room temperature (see J.4.2.2)	Not applicable
i)	for grades equal to or greater than Grade L555 or X80, a lower maximum tensile strength limit may be agreed [see Table J.2, footnote b)];	Not applicable
j)	Minimum average length other than 12,1 m (39.7 ft) and/or different range (see J.6.3)	Refer J.6.3 of API 5L.
k)	Diameter and out-of-roundness tolerances for SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table J.3, footnote b)]	Tolerances shall be as per J.6.1(Substituted).
l)	Use of inside diameter to determine diameter and out-of-roundness tolerances for non-expanded pipe with $D \geq 219,1$ mm (8.625 in) [see Table J.3, footnote c)]	Acceptable



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m)	hardness test of the pipe body seam weld and HAZ of EW and SAW pipe (see Table J.7);	Not applicable
n)	hardness testing of pipe body for SMLS pipe (see Table J.7);	Required
o)	CTOD testing (see J.8.2.2 and Table J.6);	Refer Annex B (substituted) within this specification.
p)	use of the ring expansion test for transverse yield strength determinations [see Table J.7, footnote c)];	Not applicable
q)	additional longitudinal tensile testing for deep-water pipelay [see Table J.7, footnote d)];	Not applicable
r)	deviation from hardness test [see J.8.3.2.2 c) and J.8.3.2.3];	Not Applicable
s)	deviation from location of hardness test [J.8.3.2.2.c)];	Not applicable
t)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3);	Applicable
u)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Refer K.2.1.3(Amended) and K.2.1.4 (Amended)
v)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4);	Refer K.2.1.4(Amended)
w)	ultrasonic inspection to verify conformance with the applicable requirements given in Table K.1 (see K.3.2.2);	Applicable; Refer K.3.2.2 (Amended).
x)	verification of lamination size/density (see K.3.2.2);	Applicable ; Refer K.3.2.2 (Amended).
y)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3);	Applicable; refer K.3.3 (amended).
z)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4);	K.3.4.1(Amended) is applicable
aa)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	K.3.4.1(Amended) is applicable

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bb)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Required
cc)	full-body inspection of SMLS pipe by the eddy current method (see .3.4.3);	Required
dd)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Required
ee)	Acceptance Level U2/U2H for non-destructive inspection of the weld seam of HFW pipe (see K.4.1);	Not applicable
ff)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not applicable
gg)	ultrasonic inspection of the pipe body of HFW pipe for laminar imperfections (see K.4.2);	Not applicable
hh)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3);	Not applicable
ii)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux-leakage method (see K.4.4);	Not applicable
jj)	use of fixed-depth notches for equipment standardization [see K.5.1.1 c)];	Not applicable
kk)	radiographic inspection of the pipe ends (non-inspected pipe ends) and repaired areas [see K.5.3 a)];	Not applicable
ll)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4).	Not applicable
m m)	for grades L625QO or X90QO, and L690QO or X100QO, a lower $Rt_{0.5}/R_m$ (see Table J.2).	Not applicable

J.3 Manufacturing

J.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Substituted).

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J.3.3 Pipe manufacturing

J.3.3.1 SUBSTITUTE

Steel shall be made by continuous casting only. Cold expansion shall not be permitted for seamless pipes.

J.3.3.2 Not applicable

J.3.3.3 Jointers

SUBSTITUTE

Jointers are not permitted

J.4 ACCEPTANCE CRITERIA

J.4.1 Chemical composition

SUBSTITUTE

Refer 9.2 [Table 5 (substituted)] with foot notes thereof.

Table J.1 SUBSTITUTE

Refer Table 5 (substituted) with foot notes thereof.

J.4.2 Tensile properties

J.4.2.1 SUBSTITUTE

The minimum Yield strength, minimum Tensile strength and Elongation of finished pipes (after all heat treatment and sizing operations) shall conform to the requirements of Table-J.2 of API 5L. However, other requirements of Table-J.2 are not applicable.

The actual yield strength shall be as close as possible to the specified minimum yield strength but in no case it shall be more than 133% of the specified minimum yield strength.

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

J.4.2.2 DELETE

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J.4.3 Hardness test

SUBSTITUTE

Vickers hardness tests as per ASTM E-92 shall be carried out on samples of pipes at locations indicated in Figure H.1 a) to establish that the hardness of the pipe material is less than 250 HV10. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12

J.6 Tolerances for diameter, wall thickness, length and straightness

J.6.1 SUBSTITUTE

Tolerances for diameter shall be as per Table J.3 of API Specification 5L.

Tolerances on diameter for $D \geq 219.1\text{mm}$ based on measured inside diameter finalized by the manufacturer shall conform to Table J.3 of API 5L 45th Edition.

Tolerances for out-of-roundness shall be as under:

Pipe size	Tolerances for out-of-roundness	
	Pipe except the end	Pipe end
< 60.3 mm OD to 114.3 mm OD	as indicated in Table J.3.	as indicated in Table J.3 of API 5L 45th Edition
≥ 168.3 mm OD to 273.1 mm OD	2 mm	0.01D subject to 2 mm max.
> 273.1 mm OD	3.2 mm	0.01D subject to 3.2 mm max.


J.6.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table J.4 shall not be applicable.

J.6.3 ADD

In case of LSTK contract, length of pipes shall be mutually agreed between Line pipe manufacturer and Installation Contractor.

J.7 Not applicable

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J.8 Inspection

J.8.1 Specific inspection

SUBSTITUTE

The frequency of inspection shall be as given in 10.2.1.2 of this specification.

J.8.2 Samples and test pieces for mechanical and technological tests.

SUBSTITUTE

J.8.2.1.1 For tensile tests, CVN impact tests, CTOD tests the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

J.8.2.1.2 Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in Table J.8 taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4 and J.8.2.2 of this specification.

Both transverse and longitudinal tensile test shall be carried out for each lot of 100 pipes or less, belonging to the same heat and manufactured by the same process. In case of pipe diameters i.e. 219.1 mm (8-5/8 inches) and smaller, transverse tensile test is not required.

J.8.2.2 Test Pieces for CTOD tests

SUBSTITUTE

Test pieces shall be taken from the parent metal and shall be prepared in accordance with ISO 12135, ASTM E1290, or BS 7448. The sampling procedure and position of test piece notches shall be as agreed.

J.8.2.3 Samples for hardness tests

AMEND

Refer H.7.2.8.4 of this specification.

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J.8.3 Test method

J.8.3.1 CTOD Test

SUBSTITUTE

CTOD testing shall be carried out in accordance with the requirements of BS 7448. One set of three specimens shall be taken in transverse direction. However, in case of pipe OD \leq 219.1 mm; specimen may be taken in longitudinal direction. The test shall be carried out at 0°C. Minimum acceptable critical CTOD value shall be 0.2 mm. Average CTOD value shall be reported.


J.8.3.2 Hardness test

J.8.3.2.1 SUBSTITUTE

Vickers hardness tests as per ASTM E-92 shall be carried out on samples of pipes at locations indicated in Figure H.1 a) to establish that the hardness of the pipe material is less than 250 HV10. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12 of this specification.

J.8.3.2.2 Refer H.7.3.3.3

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Annex K (AMENDED)

Non-destructive inspection for pipe ordered for sour service and / or offshore service.

K2.1.3 (AMEND)

Ultrasonic inspection with automated/semi-automated systems in accordance with ISO 10893-8 or by manual methods, as specified in Annex A of ISO 10893-8 shall be used to verify that 100mm wide zone at each pipe end is free of laminar defects.

K2.1.4 (AMEND)

Bevel ends of each pipe shall be inspected by Magnetic Particle technique checking laminar imperfections or inclusions as per ISO 10893-5 or ASTM E709. Residual magnetism after MPI shall not exceed 20 Gauss measured by Hall Effect Gauss Meter. Laminar imperfections > 6.4 mm (0.25 in) in the circumferential direction shall be classified as defects.

K.3.2.1 & K.3.2.2 (AMEND)

Acceptance criteria for laminar imperfections shall be as per table K.1 for service condition “Sour, if agreed”. The coverage during automatic inspection shall be 100% of the pipe surface.


K.3.3 (AMEND)

The coverage during inspection shall be 100% of the pipe surface.

K.3.4.1 (AMEND)

The pipe shall be ultrasonically inspected for the detection of transverse imperfections in accordance with ISO 10893-10 acceptance level U2/C ,ASTM E213.


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Addendum to Specification for Carbon Steel Seamless Line Pipe For Submarine Pipelines (Sour Service)

**OIL AND NATURAL Gas CORPORATION LTD.
INDIA**

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2	15.07.2015	0	
TOTAL NO. OF PAGES	DATE	Addendum REV.NO.	

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AMENDMENTS / ADDITIONS

Specification No. :2020B Rev.5

Title : Functional Specification for Carbon Steel Seamless Line Pipe for Submarine Pipelines (Sour Service)

Following Amendment s/ additional requirements shall be applicable:

Annexure K (Amend)

K.3.4.1 (Amend) : SMLS pipe shall be ultrasonically inspected for the detection of transverse imperfections in accordance with 10893-10 acceptance level U2/C, or ASTM E213.

AND

Either requirement of K3.4.2 (Amend) OR K3.4.3(Amend)

K.3.4.2 (Amend) : SMLS pipe shall be full body inspected using the flux leakage method in accordance with ISO 10893-3 acceptance level F2, or ASTM E570 for the detection of both longitudinal and transverse imperfections.

K3.4.3(Amend) : SMLS pipe shall be full body inspected for the detection of imperfections using the eddy current method in accordance with ISO 10893-2 acceptance level E2H/E2 , or ASTM E309.

K3.4.4(Amend) : Full body magnetic particle inspection of SMLS pipes is NOT required.

Refer Annex H2. of 2020B Rev.5 Requirements of Supplementary Non-destruction Inspection (given at Sl. No. s, t, u, v&w) are amended as Annex.K (Amend) of this Addendum.

Refer Annex J2 of 2020B Rev.5. Requirements of Supplementary Non-destruction Inspection (given at Sl. No. z, aa, bb,cc &dd) are amended as Annex.K (Amend) of this Addendum.



Offshore Design Section
Engineering Services
ISO – 9001:2000

**ADDENDUM-2 TO FUNCTIONAL
SPECIFICATION FOR
CARBON STEEL SEAMLESS
LINEPIPE FOR SUBMARINE
PIPELINES (SOUR SERVICE)**

Spec. No.	ADDENDUM TO SPEC 2020 B, REV 5
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**ADDENDUM-2 TO
FUNCTIONAL SPECIFICATION
FOR
CARBON STEEL SEAMLESS LINEPIPE
FOR
SUBMARINE PIPELINES
(SOUR SERVICE)**

Prepared By

CSR	RKP	SBD	TMK	SK	RP	NVP

Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
BPM	AKM	02	06.01.2021	0

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004A	ODS/SOP/008 to 015	02	02	29.08.2008




**Offshore Design Section
Engineering Services
ISO – 9001:2000**

**ADDENDUM-2 TO FUNCTIONAL
SPECIFICATION FOR
CARBON STEEL SEAMLESS
LINEPIPE FOR SUBMARINE
PIPELINES (SOUR SERVICE)**

Spec. No.	ADDENDUM TO SPEC 2020 B, REV 5
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Sl. No.	Clause Reference, page no.	Existing provision in spec.	Modified Clause in spec.																											
1	8.3.2 Amend Page no. 11 of 39	<p>Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced (blistering and stepwise) cracking.</p> <p>Steel shall be made by continuous casting only. Pipes shall be seamless construction.</p> <p>Manufacturing procedure as mentioned in Annex B (Substituted) of this specification shall be prepared and submitted to Company for approval prior to start of production.</p>	<p>To be read as :</p> <p><i>Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced (blistering and stepwise) cracking.</i></p> <p><i>Steel shall be made by continuous casting only.</i></p> <p><i>Steel shall be sampled for inclusion content as per ASTM E-45 and tested for Inclusion Content by JK-type inclusion ratings procedure using automatic image analysis in accordance with microscopic Method -A of ASTM E-45 and reported as per ASTM E-45.</i></p> <p><i>Maximum limit of inclusion severity level in steel, as per ASTM E-45 Standard, method A, shall be as under:</i></p> <table><tr><th>Inclusion Type</th><th colspan="2">Type A (Sulphide)</th><th colspan="2">Type B (Alumina)</th><th colspan="2">Type C (Silicate)</th><th colspan="2">Type D (Globular Oxide)</th></tr><tr><th>Severity Level</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th></tr><tr><td></td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td></tr></table> <p><i>Pipes shall be seamless construction.</i></p> <p><i>Manufacturing procedure as mentioned in Annex B (Substituted) of this specification shall be prepared and submitted to Company for approval prior to start of production.</i></p>	Inclusion Type	Type A (Sulphide)		Type B (Alumina)		Type C (Silicate)		Type D (Globular Oxide)		Severity Level	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy		1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0
Inclusion Type	Type A (Sulphide)		Type B (Alumina)		Type C (Silicate)		Type D (Globular Oxide)																							
Severity Level	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy																						
	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0																						


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SPECIFICATION
FOR
LONGITUDINAL SUBMERGED ARC WELDED LINE PIPE
FOR
SUBMARINE PIPELINES
(SOUR SERVICE)

OIL AND NATURAL GAS CORPORATION LTD.
INDIA

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40	18.04.2016	2	
TOTAL NO. OF PAGES	DATE	REV.NO.	

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	01	00	21.07.2010

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1. SCOPE

This specification establishes the minimum requirements for the materials, fabrication, inspection, testing and supply of Longitudinal Seam Submerged Arc Welded (LSAW) carbon steel line pipe to be used for submarine pipelines and risers transporting sour hydrocarbons. Line pipes furnished in accordance with this specification shall meet the requirements of **API Specification 5L, Forty-Fifth Edition and the supplementary requirements stated herein.**

All carbon steel pipes made according to this specification shall be PSL2. All material shall be suitable for sour service and shall be in accordance with NACE MR-01-75 / ISO 15156.

This specification covers LSAW line pipes of pipe sizes 406.4 mm (16 inches) thru 1219 mm (48 inches) OD and grades up to L450 (X-65). The Manufacturer shall have the license to use API monogram for manufacturing of **PSL2** pipes in accordance with the requirements of API Spec 5L, **Forty-Fifth Edition along with Annexure H and Annexure J.**

“COMPANY” means “Oil and Natural Gas Corporation Ltd.”, wherever used in this specification.


NOTE

The sections, paragraphs contained herein have the same numbering as the sections and paragraphs of API 5L, in order to facilitate reference.

In this Specification, amendments to API 5L fall into the following Categories:

ADD	Where additions have been made to the API 5L clause or paragraph.
AMEND	Where the API 5L clause has been modified. Only the modified portions will be detailed in this Specification
DELETE	Where the complete clause or paragraph is to be disregarded.
SUBSTITUTE	Where the text has been substituted for the complete clause or paragraph in API5L.
NEW	Where a New Clause is Added.

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6 PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe Grade and Steel Grade

6.1.2 ADD

Maximum pipe grade shall be up to Grade L450 (X65), where 450 represents the Yield Strength in MPa.

6.2 Delivery Condition

6.2.2 ADD

The pipes shall be produced from plates which shall be quenched and tempered or Thermo mechanical rolled to impart uniformly fine ferritic grain structure to the finished steel. Acceptable pipe manufacturing routes are as follows:

Starting Material	Pipe Forming	Final Heat Treatment	Delivery Condition
Thermo-Mechanical Rolled plate or strip	Cold Forming	None, Unless Required due to degree of Cold Forming	M
QT Plate or Strip			Q

Temperature of furnace shall be controlled and recorded and such records shall be made available to the Company.

7 INFORMATION TO BE SUPPLIED BY THE PURCHASER


7.1 General Information

The purchase order shall include the following information:

SUBSTITUTE

S.no	Information to be provided as per API 5L	Information provided by the COMPANY to be incorporated in PO/PS.
a)	quantity(e.g. total mass or total length of pipe)	As per provisions of the Contract.
b)	PSL (1 or 2)	PSL2
c)	type of pipe (see Table 2)	SAWL
d)	reference to API 5L	API Spec 5L, Forty-Fifth Edition
e)	steel grade (see 6.1, H.4.1.1 or J.4.1.1, whichever is applicable)	H.4.1.1 shall be applicable
f)	outside diameter and wall thickness (see 9.11.1.2)	As per provisions of the Purchase Specification.

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g)	length and type of length (random or approximate) (see 9.11.1.3, 9.11.3.3 and Table 12)	Refer J.6.3 of API 5L Forty Fifth edition.
h)	confirmation of applicability of Individual annexes.	The applicable Annexes as shown in the following supplementary Table:

Applicable Annexures:

	Service
Annex B(Amended)-Manufacturing procedure qualification for PSL 2 pipe	Offshore and Sour Service both.
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore and Sour Service both.
Annex D (Amended) – Repair Welding Procedure	Offshore and Sour Service both
Annex H (Amended) - PSL 2 Pipe ordered for Sour Service	Offshore and Sour Service both.
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore and Sour Service both.
Annex K (Amended) - Non-destructive inspection for pipe ordered for sour service and/or offshore service	Offshore and Sour Service both.


Note: In case of any contradiction between different clauses of this Specification, the most stringent clause shall prevail upon.

7.2 ADDITIONAL INFORMATION

SUBSTITUTE

a)	Items that are subject to mandatory agreement, if applicable:	
S.no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	pipe designation for intermediate grades [see Table 1, footnote a)]	Not applicable
2	chemical composition for intermediate grades (see 9.2.1 and 9.2.2)	Not applicable
3	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see 9.2.3)	For Quenched and Tempered Delivery Condition, Chemical Composition of Pipes shall be as per Table H.1 of API 5L, 45 Th Edition. For Thermo-mechanical rolled or


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		formed delivery condition, Chemical Composition of Pipes shall be as per Table H.1 of API 5L, 45 th Edition but the Carbon equivalent may be increased with 0.01.
4	carbon equivalent limits for PSL 2 pipe in Grade L415N or X60N (see Table 5)	Not Applicable
5	carbon equivalent limits for PSL 2 pipe in Grade L555Q or X80Q, L625Q or X90Q, and L690Q or X100Q (see Table 5),	Not applicable
6	carbon equivalent limits for PSL 2 SMLS pipe with $t > 20,0$ mm (0.787 in) [see Table 5, footnote a)],	Not applicable
7	diameter and out-of-roundness tolerances for pipe with $D > 1422$ mm (56.000 in) (see Table 10)	Not applicable
8	diameter and out-of-roundness tolerances for the ends of SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table 10, footnote b)]	Not applicable
9	standard applicable to jointer welds (see A.1.2)	Not applicable. Joints are not permitted.

b)	Items that apply as prescribed, unless otherwise agreed:	
S.no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	range of sizing ratio for cold-expanded pipe (see 8.9.2)	As per Sections 8.9.2 of API Spec 5L, Forty-Fifth Edition
2	equation for sizing ratio (see 8.9.3)	As per Sections 8.9.3 of API Spec 5L, Forty-Fifth Edition
3	chemical composition limits for PSL 1 pipe [see Table 4, footnotes c), e) and f)]	Not applicable.
4	chemical composition limits for PSL 2 pipe [see Table 5, footnotes c), e), f), g), h), i), k), and l)],	Applicable as per Table H.1 of API 5L 45 th edition. For applicable of Footnotes to Table H.1, refer Annex. H Sl.no.H2 (f) of this spec.
5	yield/tensile ratio for grades L625Q or X90Q, L690 or X100 and L830 or X120 [see Table 7, footnotes g and h or Table J.2, footnotes h and i],	Not applicable


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6	estimation and reporting of Charpy shear area (see 9.8.2.3)	Not applicable
7	tolerances for random length pipe [see 9.11.3.3 a)]	Refer J.6.3 of API 5L 45 th edition.
8	type of thread compound (see 9.12.2.4)	Not applicable
9	type of end face (see 9.12.5.1 or 9.12.5.2)	As per Sections 9.12.5.1 or 9.12.5.2 of API Spec 5L, Forty-Fifth Edition
10	International Standard applicable to Charpy testing (see 10.2.3.3, 10.2.4.3, D.2.3.4.2 and D.2.3.4.3)	Charpy V- notch testing shall be done in accordance with ASTM A370.
11	product analysis method (see 10.2.4.1),	As per Section 10.2.4.1 of API Spec 5L, Forty-Fifth Edition
12	alternate method for diameter measurement for D ≥ 508 mm (20.000 in) (see 10.2.8.1),	As per Section 10.2.8.1 of API Spec 5L, Forty-Fifth Edition
13	jointer welding type (see A.1.1),	Not applicable
14	offset of longitudinal pipe weld seams at jointer welds (see A.2.4)	Not applicable
15	repairs in cold-expanded pipe (see C.4.2)	No repair of weld seam is permitted after cold expansion of pipes. Refer Section C.4.2, Annex C of this specification.
16	alternate IQI type (see E.4.3.1);	Not applicable.


c)	Items that apply, if agreed:	
S.no.	Information to be provided as per API 5L	Information by ONGC to be incorporated in PO/PS.
1	delivery condition (see 6.2 and Table 1)	Refer 6.2.2 of this specification.
2	supply of quenched and tempered PSL 1 Grade L245 or B SMLS pipe (see Table 1),	Not applicable.
3	supply of intermediate grades [see Table 2, footnote a)]	Not applicable.
4	supply of double-seam SAWL pipe [see Table 2, footnote c)]	Not applicable
5	alternative to specified seam heat treatment for PSL 1 pipe (see 8.8.1)	Not applicable.
6	supply of SAWH pipe with coil/plate end welds at the pipe ends (see 8.10.3),	Not applicable.
7	supply of jointers (see 8.11 and H.3.3.3)	Not applicable .Jointers are not permitted
8	CVN impact test temperature lower than 0°C (32°F) (see 9.8.2.1, 9.8.2.2 and 9.8.3)	CVN impact test temperature lower than 0°C (32°F) is not applicable.

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9	CVN impact test of the pipe body of PSL 2 welded pipe with $D < 508$ mm (20.000 in) for shear fracture area (see 9.8.2.2 and Table 18)	Agreed. Applicable as per 9.8.2.2(Amended) of this Specification and Table J.6 of API 5L , 45 th Edition
10	CVN impact test of the longitudinal seam weld of PSL 2 HFW pipe (see 9.8.3 and Table 18)	Not applicable.
11	DWT test of the pipe body of PSL 2 welded pipe with $D \geq 508$ mm (20.000 in) (see 9.9.1 and Table 18)	Agreed. As per Section 9.9.1(Amended) of this specification and table 18 of API 5L, Forty fifth edition.
12	DWT test temperature lower than 0°C (32°F) (see 9.9.1)	DWT test temperature lower than 0°C (32°F) is not applicable
13	fraction jointers comprising 2 or 3 pieces for 12 m (40 ft) nominal or 24 m (80 ft) nominal, respectively [see 9.11.3.3.c), d), and e)],	Not applicable.
14	power-tight make-up of couplings (see 9.12.2.3 and 10.2.6.1)	Not applicable.
15	special bevel configuration (see 9.12.5.3)	Special bevel configuration, if required, shall be provided in Purchase order.
16	removal of outside weld bead at pipe ends of SAW or COW pipe [see 9.13.2.2 e)]	Applicable ; Refer 9.13.2.2(e) of this specification
17	weldability data or tests for PSL 2 pipe (see 9.15)	For X65 Grade Pipe only (As per 9.15 of this specification)
18	type of inspection document for PSL 1 pipe (see 10.1.2.1)	Not applicable.
19	manufacturing information for PSL 1 pipe (see 10.1.2.2)	Not applicable.
20	alternative type of inspection document for PSL 2 pipe (see 10.1.3.1)	Refer 10.1.3.1 (Amended) of this Specification.
21	use of transverse test pieces for tensile tests of SMLS pipe, not cold-expanded [see Table 20, footnote c)]	Not applicable
22	use of the ring expansion test for transverse yield strength determinations [see 10.2.3.2, Table 19 note c), and Table 20 note d)],	Ring expansion test is not applicable.
23	use of an alternative to macrographic examination (see 10.2.5.2)	Not applicable
24	hardness test during production of EW and LW pipe (see 10.2.5.3)	Not applicable

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25	specific condition to be used for hydrostatic tests for threaded and coupled pipe (see 10.2.6.1)	Not applicable
26	alternate hydro test pressure (see Table 26),	Refer 10.2.6 of this specification. (Table 26 of API 5L is Not applicable.)
27	use of minimum permissible wall thickness to determine hydrostatic test pressure (see 10.2.6.7)	Applicable
28	specific method to be used for determining pipe diameter (see 10.2.8.1)	Clause 10.2.8.1 is Applicable. Further, Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances as per J.6.1 of API 5L.
29	use of inside diameter measurements to determine diameter and out-of-roundness for expanded pipe with $D \geq 219,1$ mm (8.625 in) and for non-expanded pipe [see 10.2.8.3 and Table 10, footnote c)].	Acceptable. Refer Cl. J.6.1 and Cl.10.2.8.3 of API 5L.
30	specific method to be used for determining other pipe dimensions (see 10.2.8.7)	Proposed methods shall be subject to COMPANY approval.
31	paint-stencilled markings for couplings (see 11.1.2)	Not applicable
32	additional markings specified by the purchaser (see 11.1.4)	For segregation of pipes additional markings/colour bands may be decided by the LSTK contractors.
33	specific surface or location for pipe markings [see 11.2.2 b) and 11.2.6 b)]	Refer 11.2.2(b) of API 5L 45 th edition & 11.2.6(b) of this specification
34	die-stamping or vibro-etching of pipe (see 11.2.3)	Only low stress die stamping shall be permitted on the pipe bevel face at the opposite end to pipe stencilled markings. The low stress marking shall be the unique pipe number only. Cold die stamping is not permitted on the pipe body. In case low stress die-stamping on bevel face is technically not feasible, alternate measures shall be made for providing unique pipe number for ensuring traceability of pipes.

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35	alternative location for marking the pipe (see 11.2.4)	Marking shall be carried out at the pipe mill. Further, for pipes intended for subsequent coating, LSTK contractor shall submit the procedure for marking at coating yard ensuring the traceability of pipes.
36	alternative format for pipe length marking locations (see 11.2.6a),	Not applicable.
37	colour identification for pipe (see 11.2.7)	Applicable
38	multiple grade marking (see 11.4.1),	Not applicable.
39	temporary external coating (see 12.1.2)	Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.
40	special coating (see 12.1.3)	Not applicable
41	lining (see 12.1.4),	Not applicable
42	manufacturing procedure qualification for PSL 2 pipe, in which case, Annex B shall apply (see B.2),	Applicable. Refer Annex B (Amended) of this specification.
43	radiographic inspection of SAW seam or coil/plate end seam (see Table E.1)	Required only for First Day Production Testing and repaired area as per Annex. B (Amended), Annex. C (Amended) and Annex. K (Amended) of this Spec.
44	non-destructive inspection of PSL 1 SMLS pipe (see E.3.1.2),	Not applicable
45	NDT of EW seam welds after hydrotest [see E.3.1.3 b)],	Not applicable.
46	ultrasonic inspection of welded pipe for laminar imperfections at pipe ends (see E.3.2.3)	Required. Refer Annex. K (Amended) of this Spec.
47	ultrasonic inspection of SMLS pipe for laminar imperfections at pipe ends (see E.3.3.2)	Not applicable
48	radiographic inspection in accordance with Clause E.4,	Required only for First Day Production Testing and repaired area as per Annex. B (Amended), Annex. C (Amended) and Annex. K(Amended)
49	use of both holes and notches in ultrasonic reference standard (see Table E.7),	Acceptable
50	alternative re-inspection technique for COW seams (see E.5.5.5)	Not applicable

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51	ultrasonic inspection for laminar imperfections in the pipe body of EW, SAW or COW pipe (see Clause E.8)	Required. Refer Annex.K (Amended) of this Spec.
52	ultrasonic inspection for laminar imperfections along the coil/plate edges or the weld seam of EW, SAW or COW pipe (see Clause E.9)	Required. Refer Annex. K(Amended) of this Spec.
53	supply of welded couplings on pipe with $D \geq 355,6$ mm (14.000 in) (see F.1.4)	Not applicable
54	application of Annex G to PSL 2 pipe where purchaser shall specify the toughness test temperature, the minimum energy for each test and the minimum average energy value required for the order (see G.2),	Not applicable
55	PSL 2 pipe for sour service, in which case, Annex H shall apply (see H.2),	Applicable. Refer Annex H (Amended) of this specification.
56	TFL pipe, in which case, Annex I shall apply (see I.2),	Not applicable
57	pipe for offshore service, in which case, Annex J shall apply (see J.2),	Applicable. Refer Annex J (Amended) of this specification
58	any other additional or more stringent requirements.	As included within this document.

8 MANUFACTURING

8.1 Process of Manufacture

ADD


This specification is applicable for Longitudinal submerged arc welded pipe only. Other types of pipes specified in Table 2 and pipe for intermediate grades (refer footnote a) of Table 2 are not applicable in this specification. The pipes shall be produced from plates/ skelp which shall be quenched and tempered or Thermomechanical-rolled to impart uniformly fine ferritic grain structure to the finished steel.

8.3 Starting Material

8.3.2 AMEND

Pipes furnished to this specification shall be made to a clean steel practice using either basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed or alternative processes shall be applied. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced (blistering and stepwise) cracking. Steel shall be made by continuous casting only. Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.

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8.3.3 AMEND

The steel shall be fully killed and made with fine grain structure with a grain size of ASTM 7 or finer as per ASTM E 112.

8.9 Cold sizing and cold expansion

8.9.1 DELETE

8.9.2 ADD

The expansion shall be measured and recorded for one out of every 50 pipes.

8.11 Jointers

AMEND

Jointers shall not be permitted.

9. ACCEPTANCE CRITERIA

9.8 CVN Impact Test for PSL 2 Pipe

9.8.1.3 AMEND

Tests shall be conducted at 0°C (32°F)

9.8.2 Pipe Body Tests


9.8.2.1 AMEND

The minimum average (of a set of three test pieces) and minimum individual absorbed energy for each pipe body test shall be as given in Table 8 (substituted), based upon full-size test pieces and a test temperature of 0 °C (32 °F). Test temperature lower than 0°C (32°F) is not applicable.

TABLE 8 (SUBSTITUTED)

API 5L Table-8 is substituted as under:

Grade	Min. Average	Min. Individual
X-42	29J	22J
X-46	32J	24J
X-52	36J	27J
X-56	39J	29J
X-60	41J	31J
X-65	43J	33J

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Note: The average impact values are determined by finding the mean of the values of each group of three specimens from each sample taken separately. The minimum impact value is determined by considering the values of the individual specimens from the sample.

9.8.2.2 AMEND

The minimum average (set of three test pieces) shear fracture area for each test shall be at least 85 %, based upon a test temperature of 0 °C (32 °F).

9.8.3 Pipe weld and HAZ tests

AMEND

The minimum average (of a set of three test pieces) absorbed energy for each weld and HAZ test shall be as given in Table 8 (substituted), based upon full-size test pieces and a test temperature of 0 °C (32 °F).

9.9 DWT test for PSL 2 welded pipe

9.9.1 AMEND

For each test (of a set of two test pieces), the average shear fracture area shall be ≥ 85 %, based upon a test temperature of 0 °C (32 °F).

9.9.2 DELETE

9.10 Surface Conditions, Imperfections and Defects

9.10.1 General

9.10.1.2 ADD

No cracks shall be permitted. Section of the pipe containing cracks shall be cut off as per the requirement of clause C.3(b) or entire pipe length shall be rejected as per the requirement of clause C.3.(c) of API 5L.

9.10.1.3 AMEND


The acceptance criteria for imperfections found by non-destructive inspection shall be in accordance with Annex K (amended) of this specification.

9.10.2

(c) AMEND

Undercuts that exceed the limits specified in item b) shall be classified as defects and shall be treated in accordance with API 5L para C.3 (b) or (c).

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9.10.4 Laminations

ADD

Refer Annex K (Amended).

9.10.5 Geometric Deviations

9.10.5.2 AMEND

Depth of dent shall not exceed 2 mm and length in any direction shall not exceed half of the pipe diameter, provided this dent does not give rise to a hard spot at the internal surface exceeding 235 HV10. Disposition of dents shall be carried out in accordance with API 5L para C.3.b) or C.3.c) of Annex C. Dents on weld and HAZ are not acceptable.

9.10.6 Hard Spots

SUBSTITUTE

Any hard spot larger than 50 mm (2.0 in) in any direction shall be classified as a defect if its hardness exceeds 235 HV10 based upon individual indentations. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C.

9.10.7 Other Surface Imperfections

SUBSTITUTE


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

- Imperfections that have a depth $\leq 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1.
- Imperfections that have a depth $> 0.05t$ and do not encroach on the minimum permissible wall thickness shall be classified as defects and shall be dressed – out by grinding in accordance with Clause C.2 (Amended) or shall be treated in accordance with Clause C.3.
- Imperfections that encroach on the minimum permissible wall thickness shall be classified as defects and shall be treated in accordance with Clause C.3.(b) or C3(c).

9.11 Dimensions, Mass and Tolerances

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

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AMEND

Tables 10, 11 & 12 of API 5L shall not be applicable.

9.11.3.1 SUBSTITUTE

Tolerances for diameter and out-of-roundness shall be as per Table J.3 of API Specification 5L.

9.11.3.2 SUBSTITUTE

Wall thickness tolerance shall be as per J6.2 (Substituted) of this specification. Table 11 shall not be applicable.

9.11.3.3 SUBSTITUTE

Refer J.6.3 of API 5L.

9.11.3.4 SUBSTITUTE

The tolerances for straightness shall be as per **J.6.4** of API Specification 5L.

9.12 Finish of Pipe ends

9.12.5 Plain ends

9.12.5.1 & 9.12.5.2

ADD

Pipe ends shall be supplied with standard API bevel. However, in case of any specific requirement of bevel angle the same shall be provided in purchase order.

While removing the inside seam burrs at the pipe ends, care shall be taken neither to remove excess metal nor to form an inside cavity. Removal of excess metal beyond the minimum wall thickness as indicated in para 9.11.3.2 of this specification, shall be a cause for cutting and removal of defective section and rebeveling.


In case root face of bevel is less than specified, rebeveling shall be done and rectification shall not be made by filling or grinding.

9.13 Tolerances for the weld seam

9.13.1 Radial offset of strip/plate edges (SUBSTITUTE)

The inside and outside radial offsets of the strip/plate edges [see Figure 4 b)] shall not exceed the applicable value given in Table J.5.

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9.13.2.2 (e) (Amend)

For a distance of at least 150 mm (6.0 in) from each pipe end, the outside weld bead shall be removed by grinding such that it does not extend above the adjacent pipe surface by more than 0.5 mm (0.020 in).

9.13.3 Misalignment of the weld beads

ADD

All pipes shall be checked for out-of-line weld bead and shall be measured and recorded at least 3 times per operating shift (12 hours maximum).

Checking of the weld seam misalignment shall also be carried out on metallographic examination specimen.

9.15 Weldability Test for PSL2 Pipe

Amend

FOR GRADE X-65 ONLY Manufacturer shall carry out a weldability test to establish that quality girth welding meeting various requirements mentioned in this specification can be achieved under simulated site conditions. This test shall be carried out using pipes from any of the first three heats with highest carbon equivalent for each wall thickness and each grade of steel specified in the purchase order. In case more than one mill is proposed to manufacture pipes, the weldability test shall be carried out for each mill.


Welding procedure shall comply with the requirements of DNV-OS-F101. Procedure for field weldability test shall be submitted by the manufacturer in line with DNV-OS-F101 and approved by purchaser prior to commencement of test.

Weldability test shall include all tests listed in DNV-OS-F101 aimed at establishing the weld quality/ properties as per this specification. The acceptance criteria shall be as per the requirements of this specification. In case of failure of any test results to comply the specification requirements, manufacturer shall revise the welding procedure adopted and carry out the tests again to comply the specification requirements. Manufacturer shall submit the test results to purchaser to comply specification requirements prior to shipment of pipes.

10. INSPECTION

10.1.3. Inspection documents for PSL 2 pipe

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10.1.3.1 AMEND


Inspection certificate shall be issued and validated as per “3.1C” in accordance with ISO 10474 : 1991.

10.1.3.2 SUBSTITUTE

The manufacturer shall provide production report including acceptance test certificates as mentioned in 13 of API Specification 5L (as applicable for LSAW pipe) in six copies, which shall include the results of all testing required as per this specification and performed on raw material and delivered pipes giving details of, but not limited to the following for each pipe length:

- COMPANY's Name and Order Number;
- SUPPLIER's Identification;
- Name and location of facilities used for pipe manufacturing, plate rolling and steelmaking
- Pipe specified outside diameter, specified wall thickness, pipe grade
- Type of pipe, Product Specification Level (PSL) and delivery condition;
- Steelmaking Process;
- Identification of Steel Type and Grade;
- Slab number, as applicable;
- chemical composition (heat and product),Certificates of Ladle and Product Analysis;
- CE_{IIW} / Pcm for both Product and Ladle Analysis;
- Pipe Identification number, Heat number, Pipe length and Pipe weight
- Certified measurements for Dimensional measurements/ tolerance
- tensile test results and the type, size, location and orientation of the test pieces,Mechanical Test Certificates.
- Yield/Tensile Ratio (based on R_{t0.5});
- % Elongation of pipe;
- Charpy Impact Results;
- Hardness Tests;
- DWT test results;
- Heat Treatment Condition including review of records of furnace temperature(s);
- specified minimum hydrostatic test pressure and specified test duration, Hydrostatic Test Certificate, or statement;
- the method of non-destructive pipe body and weld inspection (radiological, ultrasonic, MPI and electromagnetic) used; and the type and size of reference indicator or image quality indicator used,NDT Procedures, NDT Records and Reports;
- Surface Inspection;
- Dimensional Control Checks;
- Manufacturing Procedure Specification and Qualification Tests;
- Macrographic and Metallographic records

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- HIC including photomicrographs ; Four Point Bend Test , Hardness test and CTOD test records;
- SSC ,HIC and Four Point Bend Test records and reports for Mill Qualification
- Information on production & shipping
- All other reports and results as required as per this specification
- NDT Operator Qualification Certificates;
- Inspection certificate issued and validated by Authorized representative of Purchaser, as per “3.1C” of ISO 10474 : 1991, in accordance with this specification.
- COMPANY Authorized representative’s Pipe Inspection and Release Note.

Such documents shall indicate pipe identification number, the origin of each individual test specimen etc. and shall be written in English only. International system of units (SI) shall be adopted. The certificates shall be valid only when signed by Company Representative. Only those pipes which have been certified by Company Representative shall be dispatched from the pipe mill.

Manufacturer shall also provide information on test failure / rejected heats etc.

10.2 Specific Inspection

10.2.1 Inspection frequency

10.2.1.2 AMEND

The inspection frequency shall be as given in Table 18 of API 5L , 45th Edition modified by Table H.3 of API 5L , 45th Edition and Table H.3 (Amended) of this Specification and Table J.6 of API 5L , 45th Edition

10.2.2 Samples and test pieces for product analysis.

ADD

Product analysis shall be carried out from finished pipes.

10.2.6 Hydrostatic Test


10.2.6.1 SUBSTITUTE

The test pressure for all sizes and grades of pipes shall not be less than the maximum pressure calculated based on either of the criteria mentioned at 10.2.6.5 (amended) and 10.2.6.6 (amended) .The test pressure shall be held for a minimum period of 15 seconds for all sizes and grades of pipes.

10.2.6.2 AMEND

The Test pressure measuring device used for hydrostatic testing shall be calibrated with a Dead Weight tester and the record shall be maintained. Calibration records shall be

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furnished to Company Representative. The calibration shall be conducted at start of a run and after a hydrostatic burst/leak failure

10.2.6.5 AMEND

The required test pressure shall produce a hoop stress of at least 95% of the specified minimum yield strength for all the grades and sizes.

10.2.6.6 AMEND

In case, pressure testing involves end sealing ram, the required test pressure shall produce a hoop stress of at least 95% of the specified minimum yield strength for all the grades and size.

10.2.7 Visual Inspection

10.2.7.1 AMEND

Each pipe shall be visually inspected to detect surface defects, with an illuminance of at least 300 lx (28 fc). Such inspection shall be over the entire external surface and shall cover as much of the internal surface as is practical.

10.2.7.2 DELETE

10.2.7.4 AMEND

Maximum hardness in suspected hard spots shall be 235 HV10. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C.

10.2.8 Dimensional testing

10.2.8.1 ADD

Further, Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 (Substituted) of this specification.

10.2.8.5 AMEND

The wall thickness at any location shall be within the tolerances specified in para 9.11.3.2 of this specification.


10.2.10 Non-destructive inspection SUBSTITUTE

Non-destructive inspection shall be in accordance with Annex K (AMENDED).

10.2.11 Reprocessing SUBSTITUTE

Reprocessing is not permitted.

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10.2.12 Retesting

10.2.12.1 Recheck Analysis SUBSTITUTE

If any parts of the full product analysis on any one of the fully analyzed pipes fail to meet the requirements of Table H.1 with foot notes thereof of API 5L 45Th Edition, either the whole heat shall stand rejected or each individual pipe shall be fully analyzed and all pipes failing to meet the requirements of Table H.1 with foot notes thereof API 5L , 45 th Edition shall be rejected.

10.2.12.2 To 10.2.12.8 Retests ADD

In case one of the test specimens fails to conform to the specified requirements, a retest on four additional pipes from the same test unit shall be made. If all re-tests give positive result, then the pipe, which gave the negative result, shall be rejected and the balance pipes of the test unit shall be accepted.

In case of negative result of one of the re-test specimens, the test unit may be rejected or each of the remaining lengths shall be tested individually. The pipes, which give results as per requirement of this specification, shall only be accepted.

11.2 Pipe markings

11.2.1 ADD

Marking shall be in English using SI units. Markings shall also include API monogram, purchase order number, item number, heat number, wall thickness (mm), pipe number, weight and grade. Weight marked shall be the actual weight of the pipe.

12. Coatings and thread protectors

12.1.2 AMEND

Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.

12.3 Bevel Protectors (New)


Both pipe ends of all pipes shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard

13 Retention of Records

ADD


In addition to the records indicated in clause 13, the manufacturer shall retain the records of all additional tests mentioned in this specification including the ultrasonic testing carried out on pipe as well as pipe ends.

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ANNEXES OF API 5L

ANNEXURES	Service
Annex B (Amended) -Manufacturing procedure qualification for PSL 2 pipe	Offshore and Sour Service both.
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore and Sour Service both.
Annex D (Amended) – Repair Welding Procedure	Offshore and Sour Service both
Annex H (Amended) - PSL 2 Pipe ordered for Sour Service	Offshore and Sour Service both.
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore and Sour Service both.
Annex K (Amended) - Non-destructive inspection for pipe ordered for sour service and/or offshore service	Offshore and Sour Service both.

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Annex B (AMENDED)

Manufacturing Procedure Qualification for PSL 2 Pipe

B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION


SUBSTITUTE

A Manufacturing Procedure Specification (MPS) outlining the successive steps and associated inspection procedures from steelmaking to finished line pipe shall be prepared and submitted to Purchaser for approval prior to start of production. Manufacture of pipes shall start only after the approval of Manufacturing Procedure. The approved Manufacturing Procedure shall be strictly followed in all phases of the production of pipes.

The Manufacturing Procedure shall as a minimum include the following information:

- Steel & Plate/Skelp maker and plant at which steel & Plate/ skelp is produced.
- Type of Furnace , Equipment and process description including steel making process with details of secondary refining process and continuous casting process, nominal weight of each heat, deoxidation practices and inclusion shape control practices.
- Target chemistry, range of intentionally added elements and those listed in API 5L along with their service Annex. H and J , limits on heat and product analysis to be placed on steel maker.
- Steelmaking and casting process control.
- Hydrogen control practices for slabs used to make plate/skelp
- Product identification and traceability practices;
- Product rework/retest/release controls for non-conformances to manufacturer's documented practices including grade intermixes/transitions and process/chemistry deviations;
- Centerline segregation controls and acceptance criteria, as applicable.
- name/location of pipe manufacturing facility.
- equipment and process description of pipe manufacturing facility;
- Plate/skelp rolling procedure indicating number of passes, their temperature and thickness reduction in each pass required by Controlled Rolling Procedure and the finishing temperature.
- Heat treatment procedure document established as per para 8.12.
- Ultrasonic testing of plates/skelp and pipes using automatic and manual equipment including details of equipment, techniques, scanning pattern, probe frequency, scanning sensitivity, reference standard for calibration, dynamic calibration procedure, method of marking defects and indicating loss of coupling, inspection and recording.
- NDT Procedures and Equipment Calibration
- Pipe making procedure including plate edge preparation, forming and any other special process proposed.

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- Welding Procedure Specification including the details of welding process, brand name, classification, size and grade of filler metal and flux, speed of welding, number of electrodes and polarity of each electrode, welding current and voltage for each wire, edge preparation, tack welding method and spacing of tack weld, details of seam tracking system for both inside and outside welding, method of checking the setup of the system, limits of internal and external weld reinforcement etc.
- Method of weld defect removal.
- Detailed methodology of cold expansion.
- Testing of chemical, mechanical and corrosion, macrographic and metallographic properties
- Ultrasonic testing of longitudinal weld seam of pipe using automatic equipment including details of equipment, scanning pattern, probe efficiency, scanning sensitivity, calibration of pipe, extent of weld length at each pipe ends not covered by probes, method of marking defect and indicating loss of coupling, inspection and records.
- Full details of radiographic testing equipment including radiographic film including radiography procedure.
- Dimensional tolerances, frequency of checking, measurement and record in a tabular form including details of instruments and equipment proposed.
- end cropping practices;
- Detail of technique proposed for measurement of weld bead misalignment, offset, end squareness and peaking at the welds.
- Hydrostatic testing including details of testing equipment, procedure and the relevant test pressure calculations including calibration/verification of equipment.
- Marking, storage and transit protection coating procedures
- product traceability practices from slab receipt to plate/coil delivery;
- product rework/retest/release controls for non-conformances to manufacturer's documented
- practices (including process, chemical/ mechanical, and dimensional deviations),
- Handling, storage, loading and shipment procedure.
- Production report formats.
- Complete details of computerized pipe tracking system.
- Project specific quality control plan


B.5 Manufacturing procedure qualification tests

B.5.1 (Amend)

Mill Qualification Tests

Mills shall be considered qualified only subsequent to successful completion of all the tests as mentioned at B.6 (**NEW**) "**Mill Qualification Tests**" of this specification. Requirement of **Mill Qualification Tests** mentioned at B6 (New) of this specification may be waived by mutual agreement between Company and the Manufacturer in case Manufacturer possess records of successful performance of these **Tests** on a previous supply of line pipes produced by the same method of manufacture, similar chemical

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composition and grade of steel and subjected to similar heat treatment provided such tests had been performed not earlier than two years prior to this enquiry. Such test certificates duly witnessed and approved by an internationally reputed independent Inspection Agency along with a description of the tests performed shall be furnished by the Manufacturer in case Manufacturer desires a waiver of these tests

MPQT/ FIRST DAY PRODUCTION TESTS

The MPS shall be qualified for each pipe nominal diameter either as a part of first day production or as a separate MPQT prior to full scale production. Two lengths of completely finished pipes (in case of only one heat on first day) or two lengths from the first two heats i.e. one pipe from each heat (in case of more than one heat on first day) of first day's production shall be selected at random for testing to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The MPQT/ first day production tests shall be carried out on pipes as per requirement of para B.5.1 (Substituted) of this specification..

The MPQT/ first day's production tests shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser Representative

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 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 Annexure.

a. Visual Examination

All pipes shall be examined visually for dimensional tolerances and apparent surface defects in accordance with 9, 10 & 11 respectively of this specification.

b. Ultrasonic Examination

The weld seam of all pipes shall be examined ultrasonically by automatic ultrasonic equipment. All ultrasonic indications suggesting imperfections in the weld shall be carefully investigated against the corresponding points on the radiographs. If the ultrasonic indication cannot be fully explained from the radiograph, a cross section of the weld, at the location of the above-mentioned ultrasonic indication shall be made in such a way that the nature of the imperfection can definitely be established.


c. Radiographic Examination

The weld seam of all pipes shall be examined radiographically for the entire length.

d. Mechanical Properties

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

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The following tests shall be conducted:

- i. Four (4) weld guided bend test specimen transverse to the longitudinal weld shall be removed. Of the four specimen, two specimen shall be used for the face bend test and two for the root bend test.
- ii. Tensile tests shall be conducted on:
 - Two (2) transverse base material specimen.
 - Two (2) transverse weld material specimen of the longitudinal weld.
 - Two (2) longitudinal base material specimen.
- iii. Six (6) weld cross-section specimen, three (3) from each end of pipe joint shall be taken for metallographic examination. Two of these shall be tested for hardness at room temperature after etching.
- iv. Fracture toughness testing specimen shall be extracted as follows:
 - Four sets of three transverse specimens each from base metal
 - One set of 3 transverse specimens with weld in middle
 - One set of 3 transverse specimens with HAZ in middle

The base metal specimen shall be tested at -10, 0, +10, 20°C for absorbed energy. The value of absorbed energy at the test temperature as per para 9.8 of this specification shall be used to evaluate the test. The sets of weld and HAZ specimen shall be tested for absorbed energy only at the same test temperature applicable as per para 9.8 of this specification.
- v. Twelve (12) DWTT specimen shall be removed from base metal in a transverse direction. The sets of 3 base metal specimen shall be tested at -10, 0, 10, +20°C for shear area. The value at the test temperature specified in para 9.9 of this specification shall be used to evaluate the test. Full transition curve shall be established for the heat.

e. CTOD Test


CTOD testing shall be carried out in accordance with the requirements of BS7448:1991.

Two sets of specimens with each set consisting of three specimens shall be taken transverse to the longitudinal weld with the notch in the weld metal and in HAZ.

Two sets of specimen with each set consisting of three specimens shall be taken from the base metal with one set in longitudinal direction and other set in transverse direction . The test shall be carried out at 0 °C.

Minimum acceptable critical CTOD value shall be 0.2 mm for BM (Base Metal) as well as WM (Weld Metal). Average CTOD values of BM, WM and HAZ shall be reported. In addition, all the data on fatigue pre-cracking front are required. (Crack length at the following positions i.e. both surfaces 25%, 50% and 75% of the specimen thickness, the minimum and the maximum angle between the crack and the plane of the notch).

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f. Corrosion Tests

- i) HIC test shall be carried out as per clause H.7.3.1.1 of API 5L & H4.3 of this specification.
- ii) Four point bend test shall be carried out as per clause H.7.3.2.1 of this specification & H.4.5 of API 5L.

g. In addition, all the remaining tests and inspections required to be conducted as per this specification shall be conducted on all the pipes selected for testing during first day production test.

B.6 (NEW) Mill Qualification Test

Prior to start of regular production, the following tests shall be carried out, in order to qualify the Mill for regular production of pipes.

Sulphide Stress Cracking Test.

Manufacturer shall carry out NACE standard tensile test (Method A) for Sulphide Stress Cracking Test in accordance with NACE standard TM-0177 (Latest). The test shall be carried out at 60, 72, 80, 90 and 100% SMYS stress levels to produce a curve. Minimum stress for failure after 720 hours shall be at least 72% of SMYS.


Hydrogen Induced Cracking Test.

The HIC test shall be carried out in accordance with NACE standard TM-0284 (Latest), "Test Method of Pipeline Steel for Resistance to Stepwise Cracking" and as specified in clause H.7.3.1.1 of API 5L The acceptance criteria for crack sensitivity ratio (CSR) shall be 1.00%.

Four Point Bend Test

Manufacturer shall carry out Four Point Bend Test using NACE solution as specified in clause H.7.3.2.1 of this specification. The acceptance criteria shall be that the specimen shall not have any SSC cracks when examined visually as well as with wet magnetic particle method.

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Annex C (AMEND)

C.2 Treatment of dressable surface defects

C.2.3 Complete removal of defects shall be verified by local visual inspection and by suitable non-destructive inspection methods as per Annexure K (amended). To be acceptable, the wall thickness in the ground area shall be in accordance with 9.11.3.2 of this specification. Further, the sum of all ground areas shall not exceed 10% of total internal and external surface area of each pipe.

C.4 Repair of defects by welding

C.4.2 ADD No repair of weld seam is permitted after cold expansion.

No repair of weld seam is permitted at pipe ends up to a length of 300 mm.

Repair welding shall be executed only after specific approval by Purchaser Representative for each repair. The defective part of the weld shall be clearly marked on the pipe so that the defect can be easily located and repaired. The repair welding shall be performed with a minimum of two passes.

Repair Welding on the pipe Body is not allowed. Defects in the pipe material such as laminations may be removed by cutting off the section of pipe containing these defects. The remaining defect-free section of the pipe will be acceptable provided its length is within the specified minimum length and the pipe ends are tested for laminations as per requirements of this specification.

No repair of a repaired weld is permitted.


C.4.6 AMENDED

After weld repair, the total area of the repair shall be ultrasonically and Radiographically inspected in accordance with Annex K and Annex. E respectively. Before expansion or hydrotest, the type of UT may be at the option of the pipe manufacturer but, after expansion or hydrotest, inspection shall be by manual UT. It would also be acceptable to carry out combined automatic and manual UT after expansion or hydrotest.

C.4.8 AMENDED

Pipe that has been repair welded shall be hydrostatically tested after repair welding in accordance with 10.2.6 of this specification.

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Annex D (Amended) – Repair Welding Procedure

D.2.4 NDT of weld repair procedure qualification test

Amend

Repaired welds shall be inspected by Ultrasonic and Radiographic inspection techniques.

D.2.5 (New)

Hardness test as specified in para H-7.3.3 & H.4.4 of this specification shall be included in the procedure qualification. The location of the hardness measurements is to be indicated taking into account the new HAZ of the repaired area.


D.2.6 (New)

Hydrogen Induced Cracking Test as specified in para H-7.3.1 & H.4.3 of this specification shall be included in the procedure qualification.

D.2.7 (New)

Four Point Bend Test as specified in para H-7.3.2 & H.4.5 of this specification shall be included in the procedure qualification.

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Annex H (AMENDED)


PSL 2 pipe ordered for sour service

H.2 Additional information to be supplied by the purchaser

Information Requirement


	Information sought as per API 5L	COMPANY's Requirement						
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see H.3.3.2.1)	Strip or plate used for the manufacture of welded pipe shall be rolled from continuously (strand) cast or pressure cast slabs. The pipe shall be SAWL.						
b)	ultrasonic inspection of strip or plate for laminar imperfections (see H.3.3.2.4) for HFW pipes	Not Applicable						
c)	supply of helical-seam pipe containing coil/plate end welds (see H.3.3.2.5)	Not applicable						
d)	chemical composition for intermediate grades (see H.4.1.1)	Not applicable						
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see H.4.1.2)	For Quenched and Tempered Delivery Condition, Chemical Composition of Pipes shall be as per Table H.1 of API 5L, 45 Th Edition. For Thermo-mechanical rolled or formed delivery condition, Chemical Composition of Pipes shall be as per Table H.1 of API 5L, 45 Th Edition but the Carbon equivalent may be increased with 0.01.						
f)	chemical composition limits [see Table H.1, footnotes c), d), e), f), i), j) and k)]	Chemical composition limits at footnotes of Table H.1 shall be as follows: <table><tr><td>Footnote</td><td>Acceptable/ Not Acceptable</td></tr><tr><td>c, d,f,i,j,k</td><td>Acceptable</td></tr><tr><td>e</td><td>Not Acceptable</td></tr></table>	Footnote	Acceptable/ Not Acceptable	c, d,f,i,j,k	Acceptable	e	Not Acceptable
Footnote	Acceptable/ Not Acceptable							
c, d,f,i,j,k	Acceptable							
e	Not Acceptable							
g)	frequency of hardness testing of the longitudinal seam weld of HFW or SAW pipe (see Table H.3)	Refer para 10.2.1.2 of this specification.						
h)	SSC test for manufacturing procedure qualification (see Table H.3)	SSC test is required in accordance with Annex B (Amended) of this specification.						
i)	alternative HIC/SWC test methods and associated acceptance criteria (see H.7.3.1.3)	Acceptance criteria shall be as per H.4.3 of this specification.						

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j)	photomicrographs of reportable HIC cracks (see H.7.3.1.4)	Photomicrographs of all the HIC test pieces shall be provided.
k)	alternative SSC test methods and associated acceptance criteria for manufacturing procedure qualification (see H.7.3.2.2)	SSC test is required in accordance with Annex B (Amended) of this specification. Alternate SSC test methods are not acceptable.
l)	deviation from hardness test (see H.7.3.3.2 and H.7.3.3.3);	Not applicable
m)	deviation from 4 hardness impressions [see H.7.3.3.2 c)];	Not applicable
n)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3)	Required
o)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Required
p)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4)	Required
q)	verification of lamination size/density (see K.3.2.2);	Applicable; refer K.5.2.1 (amended) of this specification
r)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3)	Not applicable
s)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4)	Not applicable
t)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	Not applicable
u)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Not applicable
v)	full-body inspection of SMLS pipe by the eddy current method (see K.3.4.3);	Not applicable
w)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Not Applicable
x)	limitation of individual lamination size to 100 mm ² (0.16 in ²) (see Table K.1)	Applicable
y)	acceptance level U2/U2H for nondestructive inspection of the weld seam of HFW pipe (see K.4.1)	Not Applicable
z)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not Applicable

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aa)	ultrasonic inspection of the pipe body of HFW pipe for laminar imperfections (see K.4.2)	Not Applicable
bb)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3)	Not Applicable
cc)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux leakage method (see K.4.4)	Not Applicable
dd)	use of fixed depth notches for equipment standardization [see K.5.1.1 c)]	Applicable
ee)	radiographic inspection of pipe ends (non-inspected ends) and repaired areas [see K.5.3 a)]	Refer K 5.3 of this specification
ff)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4)	Not Applicable

H.3 Manufacturing

H.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Amended)

H.3.3 Pipe manufacturing

H.3.3.3 Joints

SUBSTITUTE

Joints are not permitted

H.4.3 HIC/SWC TEST

AMEND


The acceptance criteria for crack sensitivity ratio (CSR) shall be 1.00%.

H.4.4 Hardness test

SUBSTITUTE

Vickers hardness tests as per ASTM E 384 shall be carried out on samples of pipes at locations indicated in Figure H.1 a) to establish that the hardness shall not exceed 235 HV₁₀ for the base material of pipe and 250HV₁₀ for Weld &

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HAZ. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12 of this specification.

H.7 Inspection


H.7.1 Specific inspection

SUBSTITUTE

The frequency of inspection shall be as given in Table 18 of API 5L 45th Edition except as specifically modified in Table H.3 of API 5L 45th Edition and Table H.3 (Amended) of this specification.

Table H.3 — Inspection frequency (Amended)

Type of Inspection	Frequency of inspection
Product Analysis	Two pipes per heat of steel shall be analyzed for all elements listed in Table J.1 of API 5L, 45 th Edition. When more than 100 pipes are manufactured from one heat, additional product analysis for one pipe shall be carried out for every 100 pipes or less of the same heat.
hardness testing of the longitudinal-seam weld & HAZ of welded pipe with $D < 508$ mm (20.000 in)	Once per test unit of not more than 100 lengths of pipe with the same cold expansion ratio ^a
hardness testing of the longitudinal-seam weld & HAZ of welded pipe with $D < 508$ mm (20.000 in)	Once per test unit of not more than 50 lengths of pipe with the same cold expansion ratio ^a
Non-destructive inspection	In accordance with Annex K (Amended)
CTOD test for pipe of all Grades	As per Annex B (Amended) of this specification..
SSC test (mill qualification test)	Refer Annex B (Amended)
Four Point Bend Test	One test for each of the first three heats applied; thereafter, one test for each test unit of not more than ten heats of steel.
Mill Qualification and First Day Production Test	Mill Qualification, Manufacturing Procedure Qualification test (MPQT) / First Day Production Test As per Annex B (Amended) of this specification.

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H.7.3 Test method

H.7.3.1 HIC/SWC test

H.7.3.1.1 SUBSTITUTE

The HIC test shall be carried out in accordance with NACE standard TM-0284, “Test Method for Pipeline Steels for Resistance to Stepwise Cracking”. Three specimens shall be taken from each test pipe (one across the weld, one 90° from the weld and one 180° from the weld) and shall be tested in the test solution A of NACE TM-0284 for 96 hours. The acceptance criteria for crack sensitivity ratio (CSR) shall be 1.00%. The HIC test shall be carried out on one pipe from each of the first three heats and then on one pipe from every ten subsequent heats. The selection of the specific sample heat shall be as per the decision of the Company Representative.

If one specimen fails to meet the acceptance criteria, three more specimens shall be taken from the same pipe for retests. If one of these fails, two additional pipes of the same heat shall be selected and from each of these two pipes three specimens shall be taken for retests. If one of these six specimens fails, the heat shall be rejected. If retest results are acceptable, only the pipes from which the earlier (failed) specimens were taken shall be rejected and all other pipes of the heat shall be accepted. Should a specimen fail to pass the retest, then Company Representative shall have the right to decide on the further testing to distinguish heats which can be accepted.

H.7.3.2 SSC test

H.7.3.2.1 SUBSTITUTE


SSC tests shall be performed in accordance with NACE TM0177 using test Solution A.

SSC test for mill qualification of 720 hrs test duration shall be in accordance with Annex B (Amended).

Four Point Bend Test

Four point bend test specimen preparation and size shall be as per ASTM G 39 except that thickness shall be minimum 5 mm. One set of three specimens from base metal and one set of three specimens from weld shall be machined from the middle of the pipe wall thickness. The specimen shall be machined transverse to the pipe axis. In case of specimen with weld, the specimen shall be taken with weld in the middle. The specimens shall be bent using Four point Loading jigs to reach a stress level of 72% SMYS and then immersed in NACE solution as per NACE standard TM-0177 for a period of 96 hours with the inner surface/ root in tension. Testing sequence shall be in accordance with NACE TM 0177. The acceptance criteria shall be that the specimen shall not have any SSC cracks when examined visually as well as with wet magnetic particle technique. Four point bend test shall be carried out on one pipe

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from each of the first three heats and then on one pipe from every ten subsequent heats. The selection of the specific sample heat out of every ten heats shall be as per the decision of Company's Representative.

If one specimen fails to meet the criteria, the retest and acceptance procedure shall be as mentioned in Clause H.7.3.1.1 above.

H.7.3.2.2 DELETED

H.7.3.3 Hardness test

H.7.3.3.1 AMEND


Hardness testing shall be performed using the Vickers test in accordance with ISO 6507-1 or ASTM E 384.

H.7.5 HIC/SWC retests

SUBSTITUTE

The retest and acceptance procedure shall be as mentioned in Clause H.7.3.1.1 above

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Annex J (AMENDED)


PSL 2 pipe ordered for offshore service

J.2 Additional information to be supplied by the purchaser

Information Requirement


	Information sought by API 5L	COMPANY's Requirement
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see J.3.3.2.1)	strip and plate used for the manufacture of welded pipe shall be rolled from continuously (strand) cast or pressure cast slabs.
b)	ultrasonic inspection of strip or plate for laminar imperfections (see J.3.3.2.4)	strip and plate shall be inspected ultrasonically for laminar imperfections or mechanical damage in accordance with annex K, either before or after cutting the strip or plate, or the completed pipe shall be subjected to full-body inspection, including ultrasonic inspection.
c)	supply of helical-seam pipe containing coil/plate end welds (see J.3.3.2.5)	Not applicable
d)	chemical composition for intermediate grades (see J.4.1.1)	Not applicable
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see J.4.1.2)	Refer 7.2a (3) of this specification.
f)	carbon equivalent limit for steel Grade L555QO or X80QO, L625QO or X90QO, and L690QO or X100QO (see Table J.1);	Not applicable
g)	Chemical composition limits [see Table J.1, footnote d]	Applicable.
h)	Acceptance criteria for tensile properties if determined at other than room temperature (see J.4.2.2)	Not applicable
i)	for grades equal to or greater than Grade L555 or X80, a lower maximum tensile strength limit may be agreed [see Table J.2, footnote b)];	Not applicable
j)	Minimum average length other than 12,1 m (39.7 ft) and/or different range (see J.6.3)	Refer J.6.3 of API 5L 45 th Edition.
k)	Diameter and out-of-roundness tolerances for SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table J.3, footnote b)]	Not Applicable

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l)	Use of inside diameter to determine diameter and out-of-roundness tolerances for non-expanded pipe with $D \geq 219,1$ mm (8.625 in) [see Table J.3, footnote c)]	Acceptable
m)	hardness test of the pipe body seam weld and HAZ of EW and SAW pipe (see Table J.7);	Required
n)	hardness testing of pipe body for SMLS pipe (see Table J.7);	Not applicable
o)	CTOD testing (see J.8.2.2 and Table J.6);	Refer Annex B (Amended) of this specification.
p)	use of the ring expansion test for transverse yield strength determinations [see Table J.7, footnote c)];	Not applicable
q)	additional longitudinal tensile testing for deep-water pipelay [see Table J.7, footnote d)];	Not applicable
r)	deviation from hardness test [see J.8.3.2.2 c) and J.8.3.2.3];	Not applicable
s)	deviation from location of hardness test [J.8.3.2.2.c)];	Not applicable
t)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3);	Applicable
u)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Applicable
v)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4);	Applicable
w)	ultrasonic inspection to verify conformance with the applicable requirements given in Table K.1 (see K.3.2.2);	Applicable; refer K.5.2.1 (amended) of this specification.
x)	verification of lamination size/density (see K.3.2.2);	Applicable. refer K.5.2.1 (amended) of this specification.
y)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3);	Not applicable
z)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4);	Not applicable
aa)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	Not applicable
bb)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Not applicable

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cc)	full-body inspection of SMLS pipe by the eddy current method (see .3.4.3);	Not applicable
dd)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Not applicable
ee)	Acceptance Level U2/U2H for non-destructive inspection of the weld seam of HFW pipe (see K.4.1);	Not applicable
ff)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not applicable
gg)	ultrasonic inspection of the pipe body of HFW pipe for laminar imperfections (see K.4.2);	Not applicable
hh)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3);	Not applicable
ii)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux-leakage method (see K.4.4);	Not applicable
jj)	use of fixed-depth notches for equipment standardization [see K.5.1.1 c)];	Applicable
kk)	radiographic inspection of the pipe ends (non-inspected pipe ends) and repaired areas [see K.5.3 a)];	Applicable. Refer K.5.3 of this specification
ll)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4).	Not Applicable
mm)	for grades L625QO or X90QO, and L690QO or X100QO, a lower $Rt_{0.5}/R_m$ (see Table J.2).	Not applicable

J.3 Manufacturing

J.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Amended).

J.3.3 Pipe manufacturing


J.3.3.3 Joints

SUBSTITUTE

Joints are not permitted

J.4.2 Tensile properties

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J.4.2.1 SUBSTITUTE

The minimum Yield strength and minimum Tensile strength of finished pipes (after all heat treatment and sizing operations) shall conform to the requirements of Table-J.2 of API 5L. However, other requirements of Table-J.2 are not applicable.

The actual yield strength shall be as close as possible to the specified minimum yield strength but in no case it shall be more than 133% of the specified minimum yield strength.

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

J.4.2.2 DELETE

J.4.3 Hardness test

SUBSTITUTE

Refer H.4.4 of this specification.

J.6 Tolerances for diameter, wall thickness, length and straightness

J.6.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be - 0.5 and +1.0 mm. Table J.4 shall not be applicable.

J.8 Inspection

J.8.2 Samples and test pieces for mechanical and technological tests.

J.8.2.3 Samples for hardness tests

AMEND

Refer H.7.2.4 of API 5L.


J.8.3 Test method

J.8.3.1 CTOD Test

SUBSTITUTE

CTOD testing shall be carried out in accordance with the requirements of BS7448:1991 Two sets of specimens with each set consisting of three specimens shall be taken transverse to the longitudinal weld with the notch in the weld metal and in HAZ.

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Two sets of specimen with each set consisting of three specimens shall be taken from the base metal with one set in longitudinal direction and other set in transverse direction. The test shall be carried out at 0°C.


Minimum acceptable critical CTOD value shall be 0.2 mm for BM (Base Metal) as well as WM (Weld Metal). Average CTOD values of BM, WM and HAZ shall be reported. In addition, all the data on fatigue pre-cracking front are required. (Crack length at the following positions i.e. both surfaces 25%, 50% and 75% of the specimen thickness, the minimum and the maximum angle between the crack and the plane of the notch).

J.8.3.2 Hardness test

J.8.3.2.1 AMEND

Refer H.7.3.3.1 of this specification.

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Annex K (AMENDED)

Non-destructive inspection for pipe ordered for sour service and / or offshore service.

K.1 Introduction

ADD

If during the controls carried out in the mill, defects are found to occur at a rate over or equal to 5% for a specific type of defect or defects are found after inspection/clearance by manufacturer, the Company's Representatives shall have the right to request that the quality control program be increased to an appropriate level and maintained until the defect causes are identified and eliminated. All the tests and inspections shall be carried out in the Mill at the Manufacturer's care and account.

For UT at least one level III qualified inspector shall be available at the mill for overall supervision. A level II inspector is required for shift supervision, manual weld inspection, and calibration of all systems (both manual and automated).

Location of NDT equipment in the manufacturer's facility shall be such that final inspection of weld seam of cold expanded pipe shall be performed after cold expansion and hydrotesting but may take place before cropping , beveling and end sizing.

K2.1.3 (AMEND)

Ultrasonic inspection with automated/semi-automated systems in accordance with ISO 10893-8 or by manual methods, as specified in Annex A of ISO 10893-8 shall be used to verify that 100mm wide zone at each pipe end is free of laminar defects.

K2.1.4 (Amend)

The end face/bevel at each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 10893-5 or ASTM E709. Laminar imperfections > 6.4 mm (0.25 in) in the circumferential direction shall be classified as defects.

Residual magnetism after MPI shall not exceed 20Gauss measured by Hall Effect Gauss Meter.

K2.2.3 (Amend)

Repair by welding shall be in accordance with Clause C.4 of this specification.


K.5.2

Laminar imperfections in the pipe body and on the strip/plate edges

K.5.2.1 (AMEND)

Entire strip/plate surface or 100% of the pipe body shall be ultrasonically inspected for the detection of laminar imperfections in accordance with ISO 10893-9.

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Acceptance criteria for laminar imperfections shall be as per table K.1 of API 5L 45th edition for the service condition “Sour, if agreed” for Pipe body and strip/plate surface. Such inspection shall be carried out in the pipe mill.

K.5.2.2 (AMEND)

100% of the strip/plate edges after cutting & beveling the strip/plate shall be inspected by ultrasonic testing for the detection of laminar imperfections in accordance with ISO 10893-9.

Acceptance criteria for laminar imperfections shall be as per table K.1 of API 5L 45th edition for the service condition “sour or offshore” for Strip/plate edges or areas adjacent to the weld seam with the amendment of “Minimum imperfection size considered” for length as 5mm.

The full circumference of both ends of each pipe after beveling shall be 100% ultrasonically tested for laminations, inclusions and cracks over circumferential bands of at least 100mm width.


Such inspection shall be carried out in the pipe mill.

K.5.3 Non-destructive inspection of the weld seam at the pipe ends/repared areas (Amend)

The length of weld seam at pipe ends that cannot be inspected by the automatic ultrasonic equipment and repaired areas of the weld seam (see Clause C.4 of this specification), shall be subjected to the following.

- a) For the detection of longitudinal imperfections, manual or semi-automatic ultrasonic inspection using the same inspection sensitivity and inspection parameters as is specified in K.5.1.1.
- b) For the detection of transverse imperfections, a manual/semi-automatic ultrasonic inspection using the same inspection sensitivity and parameters as is specified in K.5.1.1
For manual ultrasonic inspection, the scanning speed shall be ≤ 150 mm/s (6 in/s).
- c) The repaired areas of the weld seam shall be inspected by Radiography as per clause E.4 in addition to UT (as given at a & b above) for detection of longitudinal and transverse imperfections.


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Addendum to Specification for Carbon Steel LSAW Line Pipe For Submarine Pipelines (Sour Service)

OIL AND NATURAL Gas CORPORATION LTD.
INDIA

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2	20.12.2016	0		
TOTAL NO. OF PAGES	DATE	Addendum REV.NO.1		

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AMENDMENTS

Specification No. :2020D Rev.2

**Title : Functional Specification for Carbon Steel LSAW line Pipes for
Submarine Pipelines (Sour Service)**

Following Amendments shall be applicable:

K.5.2.2 (Amend)¹

The Strip/ Plate edges shall be ultrasonically inspected over a width of 15mm for the detection of laminar imperfections in accordance with ISO 10893-9 to acceptance limits as given in table K.1 of API 5L 45th Edition for strip plate/ edges or areas adjacent to the weld seam.



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ADDENDUM-2 TO FUNCTIONAL
SPECIFICATION FOR
LONGITUDINAL SUBMERGED
ARC WELDED LINE PIPE FOR
SUBMARINE PIPELINES (SOUR
SERVICE)

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ADDENDUM-2 TO FUNCTIONAL SPECIFICATION FOR LONGITUDINAL SUBMERGED ARC WELDED LINE PIPE FOR SUBMARINE PIPELINES (SOUR SERVICE)

Prepared By

CSR	RKP	SBD	TMK	SK	RP	NVP

Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
BPM	AKM	02	06.01.2021	0





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**ADDENDUM-2 TO FUNCTIONAL
SPECIFICATION FOR
LONGITUDINAL SUBMERGED
ARC WELDED LINE PIPE FOR
SUBMARINE PIPELINES (SOUR
SERVICE)**


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Sl. No.	Clause Reference, page no.	Existing provision in spec.	Modified Clause																											
1	8.3.2 Amend Page no. 10 of 40	<p>Pipes furnished to this specification shall be made to a clean steel practice using either basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed or alternative processes shall be applied. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced blistering and stepwise) cracking.</p> <p>Steel shall be made by continuous casting only.</p> <p>Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.</p>	<p>To be read as :</p> <p><i>Pipes furnished to this specification shall be made to a clean steel practice using either basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed or alternative processes shall be applied. The material shall be treated for inclusion shape control to increase resistance to hydrogen-induced (blistering and stepwise) Cracking</i></p> <p><i>Steel shall be made by continuous casting only.</i></p> <p><i>Steel shall be sampled for inclusion content as per ASTM E-45 and tested for Inclusion Content by JK-type inclusion ratings procedure using automatic image analysis in accordance with microscopic Method -A of ASTM E-45 and reported as per ASTM E-45.</i></p> <p><i>Maximum limit of inclusion severity level in steel, as per ASTM E-45 Standard, method A, shall be as under:</i></p> <table><tr><th>Inclusion Type</th><th colspan="2">Type A (Sulphide)</th><th colspan="2">Type B (Alumina)</th><th colspan="2">Type C (Silicate)</th><th colspan="2">Type D (Globular Oxide)</th></tr><tr><th>Severity Level</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th><th>Thin</th><th>Heavy</th></tr><tr><td></td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td><td>1.5</td><td>1.0</td></tr></table> <p><i>Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.</i></p>	Inclusion Type	Type A (Sulphide)		Type B (Alumina)		Type C (Silicate)		Type D (Globular Oxide)		Severity Level	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy		1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0
Inclusion Type	Type A (Sulphide)		Type B (Alumina)		Type C (Silicate)		Type D (Globular Oxide)																							
Severity Level	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy																						
	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0																						

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<p>FUNCTIONAL SPECIFICATION</p> <p>FOR</p> <p>HYDROSTATIC TESTING OF</p> <p>SUBMARINE PIPELINES</p> <p>OIL AND NATURAL GAS CORPORATION LTD.</p> <p>INDIA</p>															
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1.0 SCOPE				
1.1 This specification covers the minimum requirements for hydrostatic testing of submarine pipelines transporting hydrocarbons in liquid or gaseous phase and injection water.				
1.2 This specification shall be read in conjunction with the requirements of all specifications and documents included in the Contract.				
2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS				
2.1 Reference has been made in this specification to the latest edition of the following codes, standards and specifications:				
a. ANSI B 31.8 : Gas Transmission and Distribution Piping Systems				
b. ANSI B 31.4 : Liquid Petroleum Transportation Piping System.				
c. API RP 1110 : Pressure Testing of Liquid Petroleum Pipelines.				
d. ASME Sec VIII Div.1 : Boilers and Pressure Vessels Code				
e. DNV 81 : Rules for Submarine Pipelines				
f. IP Part : Institute of Petroleum Model Code of Safe Practice				
2.2 In case of conflict between the requirements of this specification and that of the above referred codes, standards and specifications, the requirement of this specification shall govern.				
3.0 GENERAL				
3.1 Hydrostatic testing of submarine pipeline system shall commence only after completion of all installation works of pipelines, risers, crossings, burial/back-filling operations and remedial works, if any.				
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<p>3.2 Hydrostatic testing shall be carried out on the entire pipeline i.e. from pig launcher to pig receiver. For incomplete pipelines, the test shall be done from stub end to the pig barrel on the originating platform.</p> <p>Where Pig launcher/receiver are not required or specified, the Contractor shall provide and install temporary launcher/receiver at the specified battery limits of the pipeline test section during the testing operations.</p> <p>3.3 Laterals and Pipe Line End Manifolds (PLEMS) which are already pre-tested at the fabrication yard, shall also be tested again along with the submarine pipeline.</p> <p>3.4 Contractor shall perform all works required for hydrostatic testing, only after obtaining prior written approval from Company Representative.</p> <p>3.5 Contractor shall furnish all the required materials, supervision, labour, equipment, including pigs, testing, inspection, monitoring services necessary for the successful cleaning, gauging, filling, batching, logging and hydrostatic testing of the pipeline system as specified herein in a manner satisfactory to the Company Representative.</p> <p>3.6 Supervisors and personnel deployed by the Contractor for the hydrostatic operations shall have adequate experience of such operations.</p> <p>3.7 In case of submarine pipelines from platform to shore, Contractor shall carry out filling operations from the offshore platform end.</p> <p>3.8 In case any in-line full bore ball/full port check valves are installed in the pipeline, Contractor shall deploy divers and ensure that the ball valves are in open position and the flapper of the check valve is locked in open position prior to carrying out any pigging operations. Valves located on the lateral connections and PLEMS shall be kept in partially open position.</p> <p>3.9 Subsequent to completing hydrostatic testing operations and acceptance by Company, Contractor shall open the flapper lock of the check valves and leave the check valve disc in normal operating position. In addition, the valves installed in lateral connections and PLEMS shall be kept in closed/open position as per the instructions of the Company Representative.</p>				
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4.0

EQUIPMENT AND INSTRUMENTATION

The Contractor shall furnish all necessary materials, equipment, instruments and consumables for performing the work. Materials and equipment shall be in good working conditions and include, but not be limited to the following:

a)

Pigs for filling, cleaning and gauging

-

Bi directional cleaning pigs with spring loaded steel wire brushes to cover the entire internal surface of the pipe, along with magnetic flange attachment to pick-up ferrous debris in the line. Pigs shall be mounted with pinger transmitters to enable tracking.

-

Bi-directional batching/displacement pigs with at least four discs.

-

Bi-directional gauging pig with 12.7 mm thick aluminum gauging plate and polyurethane discs. The aluminium plate shall have radial incision at 45° intervals. Gauging plate diameter shall be determined as per the following formula :

d

=

D-2t – (0.01 D + 0.4t + 5 I)

where

d

=

Gauging plate diameter

D

=

Nominal outer diameter of pipe

t

=

Nominal wall thickness of pipe

I


=

0.2 t, maximum 5 mm

-

Caliper pig capable of recording changes in internal pipe geometry, locating all girth welds and locating suspected faults, dents, wrinkles, buckles, out of roundness and flat spots. Caliper pig shall be capable of completing its survey in a single pass.

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The Contractor shall provide sufficient number of pigs, including spares. Unless otherwise specified, all pigs shall be capable of negotiating a minimum bend radius of 5 times pipe diameter. In case any full port check valves are installed in the pipeline. Contractor shall ensure that the distance between the driving cups of the pigs are of sufficient length to prevent bypassing while passing through the full port check valve.

b. Fill pumps : Filling pumps shall be capable of filling the pipeline at the volume rate required to maintain pig speeds as specified in section here in after. Suction piping and pump construction shall be such that the entry of air is prevented. Pump shall have minimum differential head 20% greater than the maximum head required and shall have a minimum flow rate of 400 m³/hr. If a single pump is used, a standby unit must be available.

c. Variable speed positive displacement pumps equipped with a stroke counter to pressurize the line with a known stroke and capable of exceeding the maximum test pressure by at least 20 bar.

d. Two positive displacement meters to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than one month.


e. Portable tanks of sufficient size to provide a continuous supply of water to the pump during pressurizing.


f. Bourdon pressure gauges of suitable pressure range and accuracy.

g. Dead weight testers with an accuracy of 0.01 bar measuring in increments of 0.05 bar provided with a calibration certificate not older than one month.

h. Two 48 hours recording pressure gauges having an accuracy of ± 0.1% of the full scale value, with charts and ink gauges tested with dead weight tester prior to use. These shall be installed at the test heads.

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<p>shall include the details of all materials, equipment and procedures etc. as given below:</p> <p>a. A diagram indicating all equipment, instruments, fitting, vents, valves, thermocouples, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection locations and test water intake and discharge lines.</p> <p>b. Laboratory test results of the test water, estimated amount of test water including required dosages of oxygen scavenger, bactericide corrosion inhibitor and fluorescent dye; procedure for chemicals and dye injection and control of dosages.</p> <p>c. Filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares) their location and set-up.</p> <p>d. Direction of pigging for the filling, cleaning and gauging operation.</p> <p>e. The type and sequence of pigs and the pig tracking system for cleaning and removal of air pockets. Pig inspection procedures, including procedure to be followed in case the gauging pig indicates damage.</p> <p>f. Procedure for thermal stabilization after filling.</p> <p>g. Pressure testing procedure including a complete description of all proposed equipments and instruments (including spares), their location and set-up and proposed system for observation and recording of data during the pressure test.</p> <p>h. Theoretical calculations for temperature corrections and entrapped air volume calculations.</p> <p>i. Procedure for hydrotest acceptance</p> <p>j. Procedure for detection/location and rectification of leaks.</p> <p>k. Formats for logging/recording the test data</p> <p>l. Safety precautions proposed during the test.</p>				
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Upon approval by Company any change in the procedure shall be notified to Company whose approval in writing of all such changes shall be obtained prior to start of the hydrostatic testing operations.

6.0 PROCEDURES

6.1 All necessary equipment shall be set up and checked by the Contractor to ensure conformance with the Company approved hydrotest procedure so that the pipeline is ready for hydrotesting operations.

6.2 Contractor shall be fully responsible for checking dimensions of the proposed pigs against pig-trap dimensions to ensure that the pig receipt/retrieval sequence in the proposed procedure can be achieved. All pigs shall be inspected by the Company prior to their insertion into the launcher.

6.3 Water used for cleaning and hydrotesting of the pipeline shall be clean and free from impurities. Contractor shall conduct tests on samples of water prior to its use. The analysis shall determine oxygen concentration (dissolved oxygen), suspended solids presence of micro organisms, biological growth etc.

6.4 The Contractor shall then start cleaning, filling and gauging operations. While filling the pipeline with water. Contractor shall provide a 0.150 mm screen filter, to prevent pumping mud and other foreign materials into the pipeline.

Air vents at test heads shall be kept closed at the start of filling to allow pressure to build up in front of the pig train. First filtered sea-water of volume equivalent to one percent of the length of the pipeline test section or 250 m whichever is more shall be introduced ahead of the first pig to ensure wetting, washing and rinsing away of foreign materials. This shall be followed by launching of first pig train consisting of four pigs in following sequence:


i. Cleaning pig


ii. Batching/displacement pig


iii. Cleaning pig


iv. Gauging pig

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<p>These pigs shall be separated by volumes of filtered sea-water equivalent to one percent of the length of the pipeline test section or 250 m whichever is more. The bypass of the leading cleaning pig in the first pig-train shall be kept open to make up for water ahead of the pig running down to low-sports. The first pig-train shall be propelled forward by introducing filtered sea-water into the pipeline behind it and thereby filling the entire pipeline with filtered sea-water.</p> <p>Pinger transmitter shall be installed on the leading and/or trailing pigs of each pig train. In addition, tracking equipment for these pinger transmitters shall also be provided by the Contractor.</p> <p>6.5 The pig-train speed shall be maintained between 0.5 m/s and 1 m/s by suitable adjustment of vent valve provided on the receiving test head in order to minimize the amount of air by-passing the filling pig.</p> <p>6.6 The progress of the pig-train shall be monitored continuously and the locations of the pigs in the first pig-train reported to the Company at regular intervals as and when requested to do so by the Company Representative.</p> <p>6.7 Regular samples of sea-water leaving the pipeline system after receipt of pigs shall be analyzed. The solid contents shall be measured and the results recorded. Cleaning is considered to be completed when the quantity of debris in the samples directly ahead of the last pig is less than one percent by volume.</p> <p>In case higher solid contents are noted, additional pig trains consisting of pigs as mentioned in clause 6.4 shall be run until the pipeline is cleaned of debris. However the gauging pig mentioned in clause 6.4 shall be replaced with batching/displacement pig, in case of successful gauging pig run. In case the gauging pig run made previously was not acceptable to the Company, the last pig in this pig-train shall be a gauging pig equipped with a pinger transmitter. Subsequent pig runs shall have the same requirements as those established for the first pig-train run.</p> <p>6.8 Subsequent to arrival of the pigs at the receiver, the pigs shall be removed by the Contractor in the presence of the Company Representative. Recovered pigs shall be carefully examined and details recorded. The gauging pig shall be carefully examined for any damage. A deformed,</p>				
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<p>bent or severely nicked plate or damaged pig shall be evidence of gauging pig run failure and the same is not acceptable to Company. In such cases, the Contractor shall repair and rectify the line and repeat the gauging pig-run to the satisfaction and approval of Company Representative. Any obstructions and/or faults such as dents, buckles, flat spots etc. analyzed and noted during the gauging pig-run shall be located and any necessary repair work shall be performed to rectify the same to the satisfaction of the Company.</p>				
6.9	<p>After the pipeline is cleaned of debris and gauging pig has been run, a caliper pig run shall be made. A caliper pig shall be launched using treated water as mentioned in clause 6.11, in order to check possible out-of-roundness, locate suspected faults like dents, wrinkles and flat spots along the pipeline. The pig train in this run shall consist of one batching/displacement pig and one caliper pig.</p> <p>The results of the caliper pig run and interpretation of the data gathered by it shall be analyzed by the Contractor to evaluate the internal status of the pipeline and shall be made available to the Company as soon as possible after that particular run has been completed.</p> <p>Contractor shall furnish a detailed report to the Company giving results with interpretation/analysis of caliper pig run to Company for information.</p>			
6.10	<p>The quantities of sea-water, oxygen scavenger, bactericide, corrosion inhibitor and dye pumped into the pipeline section shall be measured and recorded at intervals decided in consultation with the Company Representative.</p>			
6.11	<p>Treatment of Hydrotest Water</p> <p>The hydrotest water shall be treated with suggested dosages of hydrotest chemicals as mentioned below:</p> <ul style="list-style-type: none">- Oxygen scavenger (Sodium/ammonium bisulfite) @ 100 mg/l on 100% basis- Bactericide (Quarternary ammonium compound Quat 2c or equivalent) @ 100 mg/l as such- Corrosion inhibitor (Polyphosphate) @ min. 15 mg/l as PO₄			
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<p>However the actual dosages of these chemicals shall be decided by the Contractor taking into account the quality of the test water indicated in clause 6.3 above the Manufacturer’s recommendations. Company approval shall be obtained regarding the dosages prior to its injection into the test water. In addition test water shall be charged with fluorescent dye “Rhodamine B or equivalent” to a concentration of 15 – 20 mg/l, before being put into the pipeline system. The use of other chemicals and dyes shall be subject to Company approval.</p>				
6.12	<p>If any of the pigs are blocked at any location in the pipeline, the Contractor shall locate the position of the blocked pig and ascertain the cause of the blockage and report the results of his investigations to the Company. The Contractor shall then carry out remedial and/or repair work acceptable to Company, required to restore the pipeline system to a working condition satisfactory to the Company Representative. On completion of the repair work, the Contractor shall start-up the filling, cleaning and gauging of the pipeline system again with treated test water as described earlier.</p>			
6.13	<p>Hydrotesting shall commence only after gauging pig run and caliper pig run are satisfactory and accepted by Company Representative.</p>			
7.0	<p>PRESSURE TEST</p>			
7.1	<p>After the pipeline system has been cleaned, gauged and filled with treated sea-water and approval of the Company to commence hydrostatic pressure test has been obtained, the pressurization of the pipeline system may be commenced by the Contractor.</p>			
7.2	<p>The Contractor shall observe the temperature of the pipeline till it equalizes to the surrounding sea water (thermal stabilization) regularly at every 4 hours intervals. For this purpose thermocouples shall be installed on the pipeline at suitable locations.</p>			
7.3	<p>Test Pressure</p> <p>The minimum hydrostatic test pressure at any section of the pipeline system shall be 1.25 times the pipeline design pressure, unless a higher test pressure is specified elsewhere in the Contract.</p>			
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7.4

Pressurization

The pressurization of the pipeline shall be commenced after thermal stabilization, at a constant rate not exceeding 2 bar/minute. One pressure recording gauge shall be installed in parallel with the dead weight tester that shall permit reading of atleast 0.05 bar. Volume of Water added to the pipeline section shall be measured through a positive displacement meter and shall be recorded periodically throughout the pressurization as follows:

- Each 5 bar increment upto the 80% of test pressure as recorded by the dead weight tester.
- Each 2 bar increment between 80% to 90% of test pressure as recorded by the dead weight tester.
- Each 0.2 bar increments between 90% and full test pressure as recorded by the dead weight tester.

The pressurizing shall be cycled according to the following sequence:

- Pressurize to 50% of test pressure, hold pressure for 1 hour.
- Drop pressure to static head of test section at test head.
- Pressurize to test pressure.


In case, during the pressure hold period indicated above, a decrease in pressure is observed, the above operations shall not be repeated more than twice, after which the test section shall not be considered capable of test, until the Contractor has isolated and eliminated the cause for the lack of water tightness.

7.5

Air entrapment test

During the pressurization to full test pressure, one test shall be carried out for the calculation of air volume in the pipeline under test when the pressure is at 50% of the test pressure. Contractor shall take pressure and added volume readings and plot the same, on a suitable graph having a plot of theoretical added volume vs pressure [p = f(v)] plot. The air content in the test section shall then be established. In case the air content exceeds 0.2% of the volume of the test section, the further pressurization shall be stopped. The pressure shall be released and the air in the test

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section vented off. If after successive trails of venting the air in the test section vented off. If after successive trails of venting the air content still remains at more than 0.2% of the volume of the test section, the Contractor shall pass additional batching/displacement pigs and refill the entire pipeline with treated sea-water as mentioned above to remove the air pockets. The procedure for establishing the air content shall be repeated till the air content in the test section does not exceed the allowable limit of 0.2% of the volume of the test section. In case the air content is within 0.2% of the test section, then the pressurizing can continue.

7.6

Testing

After air entrapment test has given acceptable results and the test section has been pressurized to the specified test pressure, the test pressure the test pressure shall be held for a minimum period of 24 continuous hours, unless a higher holding period is specified elsewhere in the Contract. The injection pump shall be disconnected and all connections at the test heads shall be checked for leakage. The pressure recorders shall then be started with the charts in a real time orientation for continuous recording throughout the holding period.

During the pressure holding period the following measurements shall be recorded/reported:

- Every one hour pressure measurements from dead weight testers.
- Every two hours the ambient temperature and the pipe temperature at the thermocouples.

All data shall be recorded on appropriate forms attached to the hydrostatic test procedure manual.


8.0


ACCEPTANCE


8.1


The hydrostatic test shall be considered positive if test pressure has kept a constant value throughout the specified hold period, except for change due to temperature difference.


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<p>In case of temperature difference, the pressure change due to temperature change shall be calculated and algebraically added to the pressure value as read on the recorders. The pressure value thus adjusted shall be compared with the initial value and the test shall be considered as acceptable if the difference is $\leq \pm 0.2\%$ of test pressure. In the event the test is unacceptable, the test period shall be extended by 24 hours.</p>				
8.2	<p>If test section fails to maintain the specified test pressure after isolation, Contractor shall determine by search the location of leakage/failure and carry out the necessary repair/rectification measures by suitable methods approved by Company. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.</p>			
8.3	<p>The cost of repairs or replacements, followed by refilling and repressurizing the line, due to poor workmanship, shall be borne by the Contractor. In the event of leaks or failures resulting from faulty Company furnished materials, Contractor shall be reimbursed for furnishing all labour, equipment, materials except those materials furnished by the Company, and transportation necessary to repair and repressurize the section of the pipeline to the pressure at the time of recognition of leak or line failure. Contractor shall be entitled for compensation as per the provisions of the Contract.</p> <p>All work of reinstalling line pipe, to replace failures, shall be done in accordance with the relevant specifications included in the Contract.</p>			
8.4	<p>Contractor shall stockpile all damaged and defective pipes to storage locations designated by the Company Representative. All cracks and splits resulting from failures shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred.</p>			
9.0	<p>TERMINATION</p> <p>After the positive results of testing and all the data have been gathered, the test shall be terminated upon written approval given by the Company Representative.</p>			
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<p>Rigid pipelines shall be slowly depressurized at a moderate and constant rate not exceeding 2 bar/ minute. In case of flexible pipelines, maximum depressurization rate shall be as per manufacturer's guidelines/ recommendations.</p> <p>10.0 PRESERVATION OF PIPELINE</p> <p>In case the pipeline is specified in the Contract to be preserved, and the hydrotest water is intended to be kept in the pipeline for more than 2 months (but not exceeding 12 months) as a preservation measure, the test water shall be dosed with the chemicals as mentioned below, instead of the chemicals and dosages mentioned at clause 6.11.</p> <ul style="list-style-type: none"> - Oxygen scavenger (Sodium/Ammonium bisulphate) @ 100 mg/1 on 100% basis. - Bactericide (Alkyl Aryl Trimethyl ammonium chloride Quat 2C or equivalent @ 250 mg/1 as such) - Corrosion inhibitor (Alkyl pyridinium chloride Quat CPC or equivalent) @ 250 mg/1 as such. <p>In case of preservation, the pipeline system under such circumstances shall be kept under a positive pressure of 0.5 kg/cm². All valves isolating the pipeline system shall be kept closed.</p> <p>11.0 TEST REPORT</p> <p>A complete report signed by Contractor and the Company Representative shall be submitted upon completion of the hydrostatic testing operations for each test section.</p> <p>The report shall contain as a minimum :</p> <ul style="list-style-type: none"> - Cleaning, flushing, filling and testing procedure used - Schematic layout of cleaning, filling and testing facilities - Instruments calibration certificates - A profile of the pipeline that shows the test sites, all instrument and injection connections - Pipe filling logs and records 				
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<ul style="list-style-type: none">- Hydrotest chemicals specification, dosage, injection records- Pig specifications- Pig inspection records including photographs of the damages- Records of gauging pig survey and photographs- Records of caliper pig survey and interpretation of results- Pressurization and stabilization records- Pressure and temperature recording charts with appropriate information inscribed thereon- Dead weight tester logs and recordings- Air volume calculations- Pressure – temperature change calculations- Environmental data- Depressurization logs and records- Records and photograph of all leaks/failure				
12.0 PRECAUTIONS DURING THE TEST				
In addition to all that has been expressly described in the procedures for carrying out the test, the following requirements shall also be complied with				
12.1 During the hydrotest, no other activities shall be performed on or near the pipeline being tested.				
12.2 Signs stating “PIPE UNDER TEST – KEEP OFF” shall be placed where the test head/scrapper traps are located. Such areas shall be suitably guarded throughout the duration of the test. In case pressurizing is done from the shore end, the entire operational area shall suitably be fenced to prevent entry of unauthorized personnel.				
12.3 All personnel working on the hydrotest spread shall be instructed on the possible dangers connected with the high pressure test operations. During the testing, operations, no unauthorized personnel shall be allowed near by the test head location. Test cabin at shore shall be atleast 10 m from the pipeline so that it is not affected by the pipeline failure.				
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1.0 SCOPE


This specification covers the minimum requirements for manufacture and supply of carbon steel flanges and fittings to be installed in submarine pipeline systems transporting sweet hydrocarbons in liquid or gaseous phase and injection water.

2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition of the following codes, standards and specifications:

- a. ANSI B 31.8 : Gas Transmission and Distribution Piping Systems
- b. ANSI B 31.4 : Liquid Petroleum Transportation Piping System.
- c. ANSI B 16.5 : Steel Pipe Flanges and Flanged Fittings
- d. ANSI B 16.9 : Factory-Made Wrought Steel Butt Welding Fittings.
- e. API 1104 : Specification for Welding Pipeline and Related Facilities
- f. ASME Sec. VIII : Boiler and Pressure Vessel Code Rules for the Construction of Pressure Vessels.
- g. ASME Sec. IX : Boiler and Pressure Vessel Code Welding and Brazing qualifications.
- h. ASTM A 370 : Mechanical Testing of Steel Products.
- i. MSS-SP-44 : Steel Pipeline Flanges
- j. MSS-SP-75 : Specification for High Test Wrought Welding Fittings.
- k. DNV-1981 : Det Norske Veritas Rules for Submarine Pipelines.

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- l. API 6H : End closures, connectors and swivels
- m. MSS-SP-25 : Standard Marking System for valves, fittings, flanges and unions.

In case of conflict between the requirements of this specification and the requirement of above referred documents, the requirement of this specification shall govern.

3.0 MATERIALS

3.1 Materials used in manufacture of flanges and fittings shall be as indicated in the Purchase Requisition or as per the Piping Spec. 2004.

3.2 Fully killed carbon steel shall be used in the manufacturer of flanges and fittings.

3.3 Each heat of steel used for the manufacturer of flanges and fittings shall have carbon equivalent not exceeding 0.40, based on check analysis, calculated as per the following formula:

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


3.4 Charpy V-notch test shall be conducted at 10°C for each heat of steel used in manufacture of flanges and fittings. Test procedure shall conform to ASTM A370 for flanges and MSS-SP-75 for all fittings.


The average absorbed impact energy value of three specimens of base metal, weld metal and HAZ shall be 29 joules. Minimum impact value of any one specimen of the three specimens analysed as above shall not be less than 22 joules.

In addition, the average shear area shall comply the requirements of MSS-SP-75.

3.5 Transverse guided weld bend test shall be performed for each lot of welded fittings produced from same heat in accordance with the provisions of MSS-SP-75. The dimension “A” in guided bend test shall not exceed 4.0 times the nominal wall thickness and dimension “B” shall be equal to A + 2t + 3.2 mm. Where t is nominal thickness.

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<p>3.6 One transverse weld tensile test shall be conducted on each heat/lot of welded fittings in accordance with the requirements of MSS-SP-75.</p> <p>4.0 DESIGN AND CONSTRUCTION</p> <p>4.1 Flanges such as welding neck flanges and blind flanges shall conform to the requirements of ANSI B 16.5 for sizes $\leq 24''$ NB (excluding 22'' NB) and MSS-SP-44 for 22'' NB and 26'' NB and above.</p> <p>4.2 Fittings such as tees, elbows and reducers shall be seamless type for sizes $\leq 16''$ NB and shall be either welded or seamless type for sizes $\geq 18''$ NB. Fittings shall conform to MSS-SP-75.</p> <p>4.3 Fittings not covered in MSS-SP-75, like weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with manufacturer's standard.</p> <p>4.4 Type, face and face finish of flanges shall be as specified in Purchase Requisition.</p> <p>4.5 Stub-in or pipe to pipe connection shall not be used in the manufacture of tees. Tees shall be manufactured by forging or extrusion methods. The longitudinal weld seam shall be kept at 90° from the extrusion. Fittings shall not have any circumferential joints.</p> <p>4.6 All butt weld ends shall be beveled as per ANSI B 16.5/MSS-SP-44 as applicable for flanges and MSS-SP-75 for fittings.</p> <p>4.7 The reinforcement of inside weld seam shall be removed for a distance of 100 mm from each end of the welded fittings.</p> <p>4.8 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Sec. IX. The procedure qualification shall include impact test for weld/heat affected zone, guided bend tees and shall meet the requirements of clause 3.4, 3.5 of this specification respectively.</p> <p>4.9 Repair by welding on flanges and parent metal of the fittings is not allowed. Repair of weld seam by welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests which are applicable for regular production welding procedure qualification.</p>				
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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 its works. Such inspection and tests shall be, but not limited to, the following.

5.1.1 All flanges and fittings shall be visually inspected.

5.1.2 Dimensional check shall be carried out on finished products as per ANSI B 16.5/MSS-SP-44 as applicable for flanges and ANSI B 16.9/MSS-SP-75 as applicable for fittings and as per this specification. Fittings not covered in MSS-SP-75 shall be checked as per Manufacturer's Standard.


5.1.3 Chemical composition, mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

5.1.4 The non-destructive inspection shall be carried out as given below:

- a. All butt and repair welds for welded fittings shall be examined 100% by radiography. Acceptance limits shall be as per API 1104.
- b. When elbows of size $\geq 18''$ NB are manufactured, the first elbow of each radius, diameter and wall thickness shall be ultrasonically checked for sufficient wall thickness in areas where a minimum wall thickness is to be expected. This shall be followed by random inspection of one out of every three elbows of the same radius, diameter and wall thickness.
- c. All finished wrought weld ends shall be 100% ultrasonically inspected for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.
- d. Magnetic particle or liquid penetrant examination shall be performed on cold formed butt welding tees with extruded outlets, that are subjected to an extreme fiber elongation of greater than 5%. This test shall be carried out as per the Supplementary Requirement SR 3 of MSS-SP-75.
- e. Welds which 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 12 and Appendix 6 respectively.

5.2 Company's Inspector reserves the right to perform stagewise inspection and witness tests, as indicated in Clause 5.1 of this specification at Manufacturer's Work prior to shipment. Manufacture shall give reasonable notice of time and

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shall provide without charge reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector.

Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

6.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

- Test certificates relevant to the chemical and mechanical properties of the materials used for manufacture of flanges and fittings and per relevant standards and this specification.
- Test Reports on radiography, ultrasonic inspection and magnetic particle examination.
- Test reports of heat treatment carried out as per this specification.
- Welding procedures and welders qualification reports.
- Test certificates for each fitting stating that it is capable of withstanding without leakage a test pressure which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the fittings is to be attached without impairment of serviceability.


7.0 PAINTING, MARKING AND SHIPMENT


7.1 After all inspection and tests required have been carried out, all external surfaces shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with standard mill coating for protection against corrosion during transit and storage. The coating shall be easily removable in the field. Manufacturer shall furnish the details of paint to be used at the time of bidding.

7.2 Ends of all fittings and weld neck flanges shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for fittings and flanges. Flange face shall be suitably protected to avoid any damage during transit.

7.3 All fittings and flanges shall be marked as per MSS-SP-25.

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<div>7.4Package shall be marked legibly with suitable marking ink to indicate the following:<div>a. Manufacturer’s Name</div><div>b. Type of flange(s) and fitting(s)</div><div>c. Nominal diameter and thickness</div><div>d. Material</div></div> <div>8.0DOCUMENTATION</div> <div>8.1Manufacturer shall furnish at the time of bidding, the following documents :<div>a. Reference list of similar supplies including, all relevant details viz. Project, Year, Client, Location, Size and Service in the last five years.</div><div>b. Record of successful proof test of fittings in compliance with the requirement of Clause 9.0 of this specification.</div><div>c. Brief description of the manufacturing, heat treatment and quality control facilities of the Manufacturer’s Works.</div><div>d. Clause wise list of deviations from this specification, if any.</div></div> <div>8.2Within three weeks of placement of order, Manufacturer shall submit four copies of method of manufacture, testing and quality control procedure for raw material and finished product for Company’s approval.<p>Once the approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing of all changes shall be obtained before the flanges and fittings are manufactured.</p></div> <div>8.3Within four weeks from the approval date, Manufacturer shall submit six copies of all documents as listed in clause 8.2 of this specification.</div> <div>8.4Prior to shipment, the Manufacturer shall submit six copies of the test certificates as listed in Clause 6.0 of this specification.</div> <div>8.5All documents shall be in English Language only.</div>				
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9.0 MANUFACTURERS' QUALIFICATION


Manufacturers who intend bidding for fittings must possess the records of a successful proof test, in accordance with the provisions of ANSI B 16.9/MSS-SP-75 as applicable. These records shall be submitted at the time of bidding, qualifying the entire range of fittings offered. Failure to submit such records shall cause rejection of the offer.


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<p>FUNCTIONAL SPECIFICATION FOR FITTINGS AND FLANGES FOR SUBMARINE PIPELINES (SOUR SERVICE)</p> <p>OIL AND NATURAL GAS CORPORATION LTD. INDIA</p>															
K.P.V		REPRODUCED & RE- ISSUED FOR BID	10	12.1.05	0										
B.P.M		REPRODUCED & RE- ISSUED FOR BID	10	10.5.04	0										
		ISSUED FOR BID	10		0										
BY	APPROV ED	REMARKS	NO. OF PAGES	DATE	REV.										
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<div>CONTENTS</div> <table><tr><th>SECTION</th><th>TITLE</th></tr><tr><td>1.0</td><td>SCOPE</td></tr><tr><td>2.0</td><td>REFERENCE DOCUMENTS</td></tr><tr><td>3.0</td><td>MATERIALS</td></tr><tr><td>4.0</td><td>DESIGN AND CONSTRUCTION</td></tr><tr><td>5.0</td><td>INSPECTION AND TESTS</td></tr><tr><td>6.0</td><td>TEST CERTIFICATES</td></tr><tr><td>7.0</td><td>PAINTING, MARKING AND SHIPMENT</td></tr><tr><td>8.0</td><td>DOCUMENTATION</td></tr><tr><td>9.0</td><td>MANUFACTURERS' QUALIFICATIONS</td></tr></table>					SECTION	TITLE	1.0	SCOPE	2.0	REFERENCE DOCUMENTS	3.0	MATERIALS	4.0	DESIGN AND CONSTRUCTION	5.0	INSPECTION AND TESTS	6.0	TEST CERTIFICATES	7.0	PAINTING, MARKING AND SHIPMENT	8.0	DOCUMENTATION	9.0	MANUFACTURERS' QUALIFICATIONS
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1.0 SCOPE				
1.1 This specification covers the minimum requirements for manufacture and supply of carbon steel flanges and fittings to be installed in submarine pipeline systems transporting sour hydrocarbons in liquid or gaseous phase, in compliance to the requirements of NACE Standard MR-01-75 and Spec.2004 A of Piping Material of relevant class.				
2.0 REFERENCE DOCUMENTS				
Reference has been made in this specification to the latest edition of the following codes, standards and specifications:				
a. ANSI B 31.8 : Gas Transmission and Distribution Piping Systems				
b. ANSI B 31.4 : Liquid Petroleum Transportation Piping System.				
c. ANSI B 16.5 : Steel Pipe Flanges and Flanged Fittings				
d. ANSI B 16.9 : Factory-Made Wrought Steel Butt Welding Fittings.				
e. API 1104 : Specification for Welding Pipeline and Related Facilities				
f. ASME Sec. VIII : Boiler and Pressure Vessel Code Rules for the Construction of Pressure Vessels.				
g. ASME Sec. IX : Boiler and Pressure Vessel Code Welding and Brazing qualifications.				
h. ASTM A 370 : Mechanical Testing of Steel Products.				
i. MSS-SP-44 : Steel Pipeline Flanges				
j. MSS-SP-75 : Specification for High Test Wrought Welding Fittings.				
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<div><div>k.</div><div>DNV-1981</div><div>:</div><div>Det Norske Veritas Rules for Submarine Pipelines.</div></div> <div><div>l.</div><div>API 6H</div><div>:</div><div>End closures, connectors and swivels</div></div> <div><div>m.</div><div>NACE TM-02-84</div><div>:</div><div>Test Method Evaluation of Pipeline Steels for Resistance to Stepwise Cracking.</div></div> <div><div>n.</div><div>NACE MR-01-75</div><div>:</div><div>Material Requirements : Sulphide Stress Cracking Resistant Metallic Materials for Oil Field Equipments.</div></div> <div><div>o.</div><div>MSS-SP-25</div><div>:</div><div>Standard Marking System for valves, fittings, flanges and unions.</div></div> <div><div>In case of conflict between the requirements of this specification and the requirement of above referred documents, the requirement of this specification shall govern.</div></div> <div><div>3.0</div><div>MATERIALS</div></div> <div><div>3.1</div><div>Materials used in manufacture of flanges and fittings shall be as indicated in the Purchase Requisition or as per the Piping Spec. and Annex-I of Spec.2004.</div></div> <div><div>3.2</div><div>Fully killed carbon steel shall be used in the manufacturer of flanges and fittings.</div></div> <div><div>3.3(a)</div><div>Chemical composition of each heat of carbon steel used, on check analysis shall be in accordance with the following requirements :</div></div> <div><table><tr><th>Element</th><th>Product Analysis (%)</th></tr><tr><td>Carbon</td><td>0.25 Max.</td></tr><tr><td>Manganese</td><td>As per relevant material code, subject to max. 1.40</td></tr><tr><td>Sulphur</td><td>0.01 Max.</td></tr><tr><td>Phosphorous</td><td>0.02 Max.</td></tr><tr><td>Nickel</td><td>0.20 Max.</td></tr></table></div>					Element	Product Analysis (%)	Carbon	0.25 Max.	Manganese	As per relevant material code, subject to max. 1.40	Sulphur	0.01 Max.	Phosphorous	0.02 Max.	Nickel	0.20 Max.
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3.3(b) Each heat of steel used for the manufacturer of flanges and fittings shall have carbon equivalent not exceeding 0.40, based on check analysis, calculated as per the following formula:

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

3.4 Charpy V-notch test shall be conducted at 10°C for each heat of steel used in manufacture of flanges and fittings. Test procedure shall conform to ASTM A370 for flanges and MSS-SP-75 for all fittings.

The average absorbed impact energy value of three specimens of base metal, weld metal and HAZ shall be 29 joules. Minimum impact value of any one specimen of the three specimens analysed as above shall not be less than 22 joules.

In addition, the average shear area shall comply the requirements of MSS-SP-75.

3.5 Transverse guided weld bend test shall be performed for each lot of welded fittings produced from same heat in accordance with the provisions of MSS-SP-75. The dimension “A” in guided bend test shall not exceed 4.0 times the nominal wall thickness and dimension “B” shall be equal to A + 2t + 3.2 mm. Where t is nominal thickness.


3.6 One transverse weld tensile test shall be conducted on each heat/lot of welded fittings in accordance with the requirements of MSS-SP-75.


3.7 The maximum hardness of the base material, weld metal and heat affected zone (HAZ) shall be 248 HV5. Hardness test shall be carried out for each heat of steel used.

3.8 Heat treatment shall be carried out on all materials exposed to sour environment as per the requirements of NACE Standard MR-01-75.

3.9 Hydrogen Induced Cracking (HIC) test shall be carried out on each heat of carbon steel used. HIC test shall be performed as per NACE Standard TM-02-84. The acceptance criteria for Crack Sensitivity Ratio (CSR) shall be 0.00%.

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<div>4.0 DESIGN AND CONSTRUCTION</div> <div>4.1 Flanges such as welding neck flanges and blind flanges shall conform to the requirements of ANSI B 16.5 for sizes $\leq 24''$ NB (excluding 22'' NB) and MSS-SP-44 for 22'' NB and 26'' NB and above.</div> <div>4.2 Fittings such as tees, elbows and reducers shall be seamless type for sizes $\leq 16''$ NB and shall be either welded or seamless type for sizes $\geq 18''$ NB. Fittings shall conform to MSS-SP-75.</div> <div>4.3 Fittings not covered in MSS-SP-75, like weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with manufacturer's standard.</div> <div>4.4 Type, face and face finish of flanges shall be as specified in Purchase Requisition.</div> <div>4.5 Stub-in or pipe to pipe connection shall not be used in the manufacture of tees. Tees shall be manufactured by forging or extrusion methods. The longitudinal weld seam shall be kept at 90° from the extrusion. Fittings shall not have any circumferential joints.</div> <div>4.6 All butt weld ends shall be beveled as per ANSI B 16.5/MSS-SP-44 as applicable for flanges and MSS-SP-75 for fittings.</div> <div>4.7 The reinforcement of inside weld seam shall be removed for a distance of 100 mm from each end of the welded fittings.</div> <div>4.8 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Sec. IX. The procedure qualification shall include impact test for weld/heat affected zone, guided bend test, hardness test and HIC test and shall meet the requirements of clause 3.4, 3.5,3.7 and 3.9 of this specification, respectively.</div> <div>4.9 Repair by welding on flanges and parent metal of the fittings is not allowed. Repair of weld seam by welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests which are applicable for regular production welding procedure qualification.</div>				
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5.0INSPECTION 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 is works. Such inspection and tests shall be, but not limited to, the following.

5.1.1

All flanges and fittings shall be visually inspected.

5.1.2

Dimensional check shall be carried out on finished products as per ANSI B 16.5/MSS-SP-44 as applicable for flanges and ANSI B 16.9/ MSS-SP-75 as applicable for fittings and as per this specification. Fittings not covered in MSS-SP-75 shall be checked as per Manufacturer’s Standard.

5.1.3

Chemical composition, mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

5.1.4

The non-destructive inspection shall be carried out as given below:

a.

All butt and repair welds for welded fittings shall be examined 100% by radiography. Acceptance limits shall be as per API 1104.

b.

When elbows of size ≥ 18” NB are manufactured, the first elbow of each radius, diameter and wall thickness shall be ultrasonically checked for sufficient wall thickness in areas where a minimum wall thickness is to be expected. This shall be followed by random inspection of one out of every three elbows of the same radius, diameter and wall thickness.

c.

All finished wrought weld ends shall be 100% ultrasonically inspected for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.


d.


Magnetic particle or liquid penetrant examination shall be performed on cold formed butt welding tees with extruded outlets, that are subjected to an extreme fiber elongation of greater than 5%. This test shall be carried out as per the Supplementary Requirement SR 3 of MSS-SP-75.

e.

Welds which 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 12 and Appendix 6 respectively.

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<p>7.2 Ends of all fittings and weld neck flanges shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for fittings and flanges. Flange face shall be suitably protected to avoid any damage during transit.</p> <p>7.3 All fittings and flanges shall be marked as per MSS-SP-25.</p> <p>7.4 Package shall be marked legibly with suitable marking ink to indicate the following:</p> <ul style="list-style-type: none">a. Manufacturer’s Nameb. Type of flange(s) and fitting(s)c. Nominal diameter and thicknessd. Material <p>8.0 DOCUMENTATION</p> <p>8.1 Manufacturer shall furnish at the time of bidding, the following documents :</p> <ul style="list-style-type: none">a. Reference list of similar supplies including, all relevant details viz. Project, Year, Client, Location, Size and Service in the last five years.b. Record of successful proof test of fittings in compliance with the requirement of Clause 9.2 of this specification.c. Brief description of the manufacturing, heat treatment and quality control facilities of the Manufacturer’s Works.d. Clausewise list of deviations from this specification, if any. <p>8.2 Within three weeks of placement of order, Manufacturer shall submit four copies of method of manufacture, testing and quality control procedure for raw material and finished product for Company’s approval.</p> <p>Once the approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing of all changes shall be obtained before the flanges and fittings are manufactured.</p>				
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<p>8.3 Within four weeks from the approval date, Manufacturer shall submit six copies of all documents as listed in clause 8.2 of this specification.</p> <p>8.4 Prior to shipment, the Manufacturer shall submit six copies of the test certificates as listed in Clause 6.0 of this specification.</p> <p>8.5 All documents shall be in English Language only.</p> <p>9.0 MANUFACTURERS’ QUALIFICATIONS</p> <p>9.1 Manufacturer who intend bidding for flanges and fittings must submit the previous supply record including all relevant details as mentioned in clause 8.1 (a) of this specification, to establish that the flanges and fittings suitable for Sour Service requirements have been successfully supplied in the last five years. Manufacturer who has not supplied the flanges and fittings suitable for Sour Service in the last five years are not acceptable.</p> <p>9.2 Manufacturer who intend bidding for fittings must possess the records of a successful proof test, in accordance with the provisions of ANSI B 16.9/MSS-SP-75 as applicable. These records shall be submitted at the time of bidding, qualifying the entire range of fittings offered. Failure to submit such records shall cause rejection of the offer.</p>				
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SPECIFICATION
FOR
SUBSEA BALL VALVES
(SOUR SERVICE)

OIL AND NATURAL GAS CORPORATION LTD.
INDIA

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Total No. of Pages	Date		Rev.No.



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1.0 SCOPE

1.1 This Specification covers the minimum requirements for Design, Manufacture and supply of Carbon Steel –NACE Ball Valves of size 2" and above and ANSI class upto 2500# for use in submarine pipeline systems handling sour hydrocarbons in liquid or gaseous phase in compliance with the requirements of API 6DSS, NACE Standard MR-01-75 and special requirements as described in this specification.

2.0 REFERENCE DOCUMENTS

2.1 All valves shall be manufactured and supplied with API monogram in accordance with the American Petroleum Institute (API) Specification 6DSS, Latest Edition, with additional requirements as indicated in the following sections of this specification.

2.2 Reference has also been made in this specification to the latest edition of the following Codes, Standards & Specifications:

- a. ASME B-31.8 : Gas Transmission and Distribution piping Systems
- b. ASME B-31.4 : Liquid Petroleum Transportation Piping Systems.
- c. ASME B-16.5 : Steel Pipe Flanges and Flanged Fittings.
- d. ASME B-16.25 : Butt-welding Ends
- e. ANSI 16.34 : Steel Valves
- f. API 1104 : Specification for Welding Pipeline and Related Facilities.
- g. ASME-Sec. VIII : Boilers & Pressure Vessel Code
ASME-Sec. IX
- h. ASTM-A-370 : Mechanical Testing of Steel Products.



- i. MSS-SP-6 : Standard Finishes for Contact Faces of Pipe Flange and Connecting-end Flanges of Valves and Fittings.
- j. MSS-SP-44 : Steel Pipeline Flanges
- k. NACE MR- 01-75 : Material requirements Sulphide Stress Cracking Resistant Metallic Materials for Oil Field Equipments.
- l. NACE TM-02-84 : Test Method Evaluation of Pipeline Stress for Resistance to Stepwise Cracking.
- m. NACE-TM-01-77 : Laboratory testing of metals for resistance to sulphide stress cracking and stress corrosion cracking.
- n. SSPC-VIS-1 : Steel Structures Painting Council-Visual Standard.
- o. DNV-1981 : Det Norske Veritas Rules for submarine pipeline.
- p. ASME B 31.3 : Chemical Plant and Petroleum Refinery Piping.

3.0 MATERIALS

3.1 All Materials used for various valve components exposed to sour environment shall comply to the requirements of NACE Standard MR – 01- 75 and Cl.8.7 of API6DSS. All sour service material shall meet special testing viz. HIC and inclusion count check (as per ASTM E 45). Material for major components of the valves shall be as indicated in Valve Data Sheet. Other components shall be as per relevant Codes & Standards. Company's written approval shall be taken in this regard.



- 3.2 Unless specified otherwise, Charpy V-notch test on each heat of base material shall be conducted as per API 6DSS, for all pressure containing parts such as body, end flanges, welding ends as well as the bolting material for pressure containing parts. Unless specified otherwise, the Charpy impact test shall be conducted at 0°C .

The Impact requirements shall be as per API 6DSS.

- 3.3 Seal material if provided shall be resistant to amine based corrosion inhibitors.

4.0 DESIGN AND CONSTRUCTION

- 4.1 Valves shall be designed for permanent subsea installation in water depths and service conditions as indicated in the Data Sheet. In addition corrosion allowance indicated in Valve Data Sheet shall be considered in valve design.

- 4.2 Valve design shall meet the requirements of API Specification 6DSS and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of ANSI B31.3.

- 4.3 Valve body shall be fully welded type design. Split body designs and body joints with threads are not permitted.

- 4.4 Valves shall be Full Bore (FB) or Reduced Bore (RB) as indicated in the Valve Data Sheet. Full bore valves shall be suitable for the passage of all types of pipeline scraper and inspection pigs on a regular basis without causing damage to either the valve components or the pig. The valve bore shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore size of reduced bore valves shall conform to API 6DSS.



- 4.5 Ball mounting shall be trunnion type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable.
- 4.6 Valve seats shall be primary metal to metal contact type. Non-metallic elastomeric O-rings or other seals for drip-tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation at maximum differential pressure corresponding to valve class rating. The seat rings shall be spring energised to ensure sealing at low differential pressure. For sealing at higher pressure, the seat rings shall be line pressure energised. Internal surface of valve body in contact with valve seats shall be provided with minimum 3.0 mm thick overlay (deposited by welding) of corrosion resistant material.
- 4.7 Where necessary, seals shall be provided on the valve body to prevent leakage from the valve to the environment and to prevent sea water leakage into the valve under as installed conditions. The external hydrostatic pressure considered in design shall correspond to a pressure of 1.5 times the hydrostatic head at the installation location.
- 4.8 Body cavity over-pressure shall be prevented by self relieving seat rings/assemblies. A pressure relief hole in the ball is not permitted.
- 4.9 Valve design shall avoid bimetallic corrosion between carbon steel and high alloy components used in the assembly. Suitable insulation shall be provided as required.
- 4.10 Valves shall be designed to withstand a sustained internal vacuum in both open and closed positions.



- 4.11 Valves of size 8" NB and above shall have the provision for secondary sealant injection under full line pressure for seat and stem seals suitable for sub-sea environment and operation by diver. Sealant injection points shall be provided with a needle valve accommodating a sealant fitting.
- 4.12 Valve design shall ensure repair of gland packing under full line pressure.
- 4.13 a. Valve ends shall be either flanged or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast body valves shall be integrally cast with the body of the valve. Face to face/end to end dimensions shall conform to API 6DSS.
- b. Flanged end shall have dimensions as per ANSI B 16.5 for sizes upto 24" NB (excluding 22" NB) and as per MSS-SP-44 for sizes 22" NB and 26" NB and above. Flange face shall be either raised face or ring joint type as indicated in purchase requisition. Flange face finish shall be serrated or smooth as indicated in the Valve Data Sheet. Smooth finish when specified shall be 125 to 200 AARH.
- c. Butt weld end preparation shall be as per ANSI B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of valve neck end and connecting pipe, the bevel end of valve shall be prepared as per ANSI B 31.8 or ANSI B 31.4 as applicable.
- 4.14 Design of weld end valves shall be such that during field welding operations, the soft seals are not liable to be damaged.
- 4.15 Valves shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions.



- 4.16 Valves of size > 8" NB shall be equipped with support foot and lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs. Height of support foot shall be kept minimum.
- 4.17 Valves shall have locking devices to be locked either in full open (LO) or full close (LC) position when indicated in the Valve Data Sheet. Locking devices shall be designed for operation by diver with minimal effort and shall be permanently attached to the valve operator and shall not interfere with operation of the valve.
- 4.18 Valves shall be provided with antistatic devices to ensure electrical continuity between stem and valve body.
- 4.19 **Operating Devices**
- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes upto and including 4" NB shall be wrench operated and valve sizes > 6" shall be gear operated. Valves design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
 - b. The power actuator shall be in accordance with the Company specification issued for the purpose.
 - c. Operating devices shall be designed for easy operation of valve under maximum differential pressure corresponding to the valve rating.
 - d. Manual operator shall be configured such that operation of the valve by the diver is possible. Manufacturer shall demonstrate that diver operation is readily achievable.



- e. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 35 kg. Manufacturer shall also indicate the number of turns of hand wheel (in case of gear operators) required for operating the valve from full open to full close position.
- f. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- g. Gear operators, if specified, shall have a self locking provision and shall be fully encased in water proof/splash proof enclosure and shall be filled with suitable grease.

4.20 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, hardness test and HIC test.

4.21 Repair by Welding is not allowed for fabricated and forged body valves. Repair by welding is permitted for cast body valves subject to written approval by Company and shall be carried out as per ANSI B 16.34. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall include impact test, hardness test and HIC test.

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 valves shall be visually inspected.



- 5.1.2 Dimensional check shall be carried out as per the Company approved drawings.
- 5.1.3 Chemical composition and mechanical properties including hardness and corrosion properties shall be checked as per relevant material standards and this specification, for each heat of steel used.
- 5.1.4 a. Non-Destructive examination of individual valve material and components consisting of but not limited to castings, forgings, plate and assembly welds shall be carried out by the Manufacturer.
- b. Valve body castings of all valves shall be radiographically examined on 100% of the surface of critical areas as per ANSI B 16.34. Procedure and acceptance criteria shall be as per ANSI B16.34.
- c. Valve forgings and valve bodies fabricated from plates shall be ultrasonically examined in accordance with the procedure and acceptance standard of Annexure E of ANSI B16.34
- d. Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of 5.1.4 b) for cast components or 5.1.4 c) for forged components and plates.
- 5.1.5 Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ANSI B 31.8 or ANSI B 31.4 as applicable and API 1104.
- 5.1.6 Welds which in Company's opinion cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII Appendix U and Appendix VI respectively.



- 5.1.7 a. All finished wrought weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end.
Laminations shall not be acceptable.
- b. Weld ends of all cast valves shall be 100% radiographically examined and acceptance criteria shall be as per ANSI B16.34.
- c. After final machining all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm shall be rejected. Further, the defects measuring between 6.35 mm and 1.59 mm which are separated by a distance less than 50 times their greatest length shall be rejected. Rejectable defects must be removed.
Weld repair of bevel surface is not permitted.
- 5.1.8 All valves shall be tested in compliance with the requirements of API 6DSS.
- 5.1.9 A supplementary low pressure gas seat test as per Annexure B, Cl.B.3 of API 6DSS shall be carried out.
- 5.1.10 A Check shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of Cl. 4.9 of the specification.
- 5.1.11 Hyperbaric qualification testing as per Annexure B, B.5 of API 6DSS for each size and pressure rating shall be carried out.
- 5.1.12 Cathodic protection continuity test is to be carried out as per the requirement of Annexure B, Cl.B.6 API 6DSS.
- 5.1.13 Seal type test is to be carried out as per the requirement of Annexure B, Cl.B.7 API 6DSS.



5.1.14 Cavity relief Testing as per Annexure B, Cl.B.13 of API 6DSS is to be carried out.

5.1.15 Valves shall be subjected to Operational Torque Test as per Annexure B, Cl.B.11 of pressure corresponding to the valve rating. The maximum hand wheel force shall not exceed 35 Kg.

5.1.16 Power actuator shall be tested after assembly at the valve Manufacturer's Works. Actuator shall be capable of allowing minimum five consecutive "opening" and "closing" cycles. To achieve this, the Manufacturer shall provide a reverse automatic control gear for uninterrupted "closing" and "opening" operations.

This test shall be conducted on all valves. In case the test does not meet the requirement, re-testing/rejection of the lot shall be as decided by Company's Inspector.

The actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Actuator Data Sheet issued for the purpose.

The manual over ride provided on the actuator shall also be checked.

It shall be demonstrated that there is no internal leakage when the valve is subjected to an external pressure equivalent to that at 1.5 times the depth indicated in the Valve Data Sheet. The valve internal pressure shall be ambient during the demonstration.

For power actuated valves, the torque required to open and close the valve shall be measured. The measurements shall produce curves of torque vs. valve position for at least three opening and three closing cycles without internal pressure and three opening and three closing cycles with maximum differential pressure, Data measurement shall be measured at 15 degree intervals minimum including 0 and



90 degrees. Valve shall be opened and closed through total of 100 cycles with maximum differential pressure. The torque test shall be repeated. The torque change after 100 cycles shall not prevent the valve from meeting the specified performance requirements.

- 5.2 Company reserves the right to perform stagewise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's Inspector.

Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his Inspector relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

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 EXTENT OF INSPECTION AND TESTING

Company or its representatives reserve the right to witness all the tests like hydrostate testing and functional testing of the valves.



7.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates:

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- c. Test reports of radiograph and ultrasonic inspection.
- d. Test report of valves confirming to clause 5.1.8 to 5.1.16 of this specification.
- e. Certificate regarding the maximum bending moment permissible for each type, size and rating of the valves.
- f. Certificate regarding the maximum hydrostatic head for which the valve is suitable for installation.
- g. All other test reports and certificates as required by API 6DSS and this specification.

The certificates shall be valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.



8.0 PAINTING, MARKING AND SHIPMENT

- 8.1 Painting shall be done in accordance to the “Functional specification for Installation of sub-marine pipelines and related facilities Spec. No. 2015”.
- 8.2 In addition to the corrosion resistant paint for long time subsea application, entire valve surface shall be provided with suitable antifouling coating to overcome rapid growth of fouling organisms / marine growth during the operational life of the valve. Special attention shall be paid to the valve position indicator and the outlets/connections requiring access during diver operation. Points requiring access during diver operation shall be coated with radium/phosphorescent materials which can absorb the light and retain the glow, so that these points can be easily identified before valve operation.
- 8.3 All bolting and nuts exposed to the sea water environment shall be coated with PTFE or shall be plated with Zinc as per ASTM B 633 Type II SC3.
- 8.4 All valves shall be marked as per API 6DSS. The units of marking shall be metric except nominal diameter which shall be in inches. In addition to the API marking, water depth to which the valve has been designed to be installed shall also be indicated clearly.
- 8.5 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.6 All sealant lines and other cavities of the valve shall be filled with sealant before shipment.



8.7 Packaging and shipping instructions shall be as per API 6DSS.

8.8 On packages, the following shall be marked legibly with suitable marking ink:

- a. Order Number
- b. Manufacturer's Name
- c. Valve size and rating
- d. Tag Number.

9.0 SPARES AND ACCESSORIES

9.1 Contractor shall provide spare parts needed for start up and commissioning.

9.2 Contractor shall also recommend a list of tools & spare parts (with prices) needed for two year normal operation maintenance.

10.0 DOCUMENTATION

10.1 At the time of bidding, Manufacturer shall submit the following documents:

- a. General arrangement drawings showing all features and relative positions and sizes of vents, drains, gear operator/actuator and other external parts together with overall dimensions.
- b. Sectional drawing showing major parts with reference numbers and material specification.
- c. Referenced list of similar supplies of ball valves shall be furnished. In case of full bore ball valves, manufacturer shall furnish all relevant details including Project, Year, Client, Location, Size, Rating, Service, Water depth, etc. wherein the ball valves have been installed in piggable pipelines in the last five years.



- d. Details of corrosion resistant paint, anti-fouling coating and radium/phosphorescent coating proposed to be applied on the valve surface as per the requirements of clause 8.2 of this specification.
- e. Clausewise list of deviations from this specification, if any.

10.2 Within three weeks of placement of order, the Manufacturer shall submit four copies of, but not limited to, the following drawings, documents and specifications for Company's approval:

- a. Detailed sectional drawings showing all parts with reference numbers and materials specification.
- b. Assembly drawings with overall dimensions and features.
- c. Fabrication details of all valves.
- d. Welding Procedures, Heat treatment procedures and Testing procedures.

Manufacturer of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

10.3 Within 30 days from the approval date, Manufacturer shall submit to Company one reproducible and six copies of all approved drawings, documents and specifications as listed in clause 10.2 above.

10.4 Prior to shipment, Manufacturer shall submit to Company one reproducible and six copies of the following:

- a. Test certificates as listed in clause 7.0 of this specification.




- b. Manual for installation, erection instructions, maintenance and operation instructions including a list of recommended spares for the valves.

10.5 All documents shall be in English only.

11.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for sub-sea ball valves must submit along with the Bid, the relevant information and details as mentioned in clause 10.1 (c) of this specification, to establish that the type of valve offered are field proven for permanent sub-sea installation in similar service and are functioning satisfactorily.


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1.	Valve Manufacturer	:	
2.	Valve Design & Manufacturing standard	:	API 6DSS read with 2025B Revision 2
3.	Valve Size, inch	:	8"
4.	Spec. No.	:	2025B
5.	Service	:	Well Fluid (Sour Service)
6.	Installation Water Depth	:	100 m
7.	a) Bore	:	As per Sl. No. 11 below
	b) Type of Ends	:	Flanged RTJ
8.	Operator Details	:	Hydraulic Actuator for sizes 8" and above
9.	Valve Material Specification (or equivalent/superior)		
	Body	:	ASTM A216 Gr WCB/ A105/A516
	Ball	:	SS316L/DSS
	Body Seat Rings	:	SS316L/DSS
	Secondary Seat Seal	:	PTFE
	Stem	:	ASTM A182 F316L/ DSS
	Stem Seal	:	PTFE
	Studs/Nuts	:	ASTM A193Gr B7 M/ A194 Gr 2HM (Xylan Coated)
10.	Design life	:	25 years
11.	Valve Locations & Quantities	:	

Sl. No.	Subsea Ball Valve Location Description	Type	Rating	SSBV Size	SSBV Quantity
1	8" OIL WO-16 to 30" ICP-Heera Pipeline Tie-in	FB	#1500	8"	2 Nos.
				2" (for venting)	2 Nos.

12.	Pipeline design conditions		
	a) Design Pressure	:	Refer Process design criteria
	b) Design Temperature	:	Refer Process design criteria
	c) Corrosion allowance	:	6 mm
	d) Design Factor	:	0.5
	e) Location	:	Subs

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Notes:


1. This valve data sheet shall be read in conjunction with specification no. 2025B Rev 2.
2. All valve material shall comply with the requirements of NACE standard MR-01-75.
3. All castings shall go 100% radiographic examination as per ANSI B 16.34.
4. Valve operation of 6" and above size shall be done by mobile HPU kept on a boat with the help of the diver by LSTK contractor. Providing of HPU and umbilical is not in the scope of this tender.
5. Contractor shall be responsible to make the valves functional, subsequent to installation of these assemblies and shall demonstrate the same to the Company Representative by suitably opening and closing the valves. For actuated valves, the opening and closing of 3 cycles of valves after offshore installation at subsea shall be demonstrated by use of portable nitrogen cylinders by divers. The demonstration shall be video recorded and submitted to the Company Representative.

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1.0

SCOPE

1.1

This Specification covers the minimum requirements for Design, Manufacture and supply of carbon steel flow tees to be installed in submarine pipeline systems transporting non sour hydrocarbons in liquid or gaseous phase.

2.0

REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition of the following Codes, Standards & Specifications:

a.

ASME B-31.8

:

Gas Transmission and Distribution piping Systems.

b.

ASME B-31.4

:

Liquid Petroleum Transportation Piping Systems.

c.

ANSI-B-16.9

:

Factory Made Wrought Steel Butt Welding Fittings.

d.

API-1104

:

Specification for Welding of Pipelines and Related Facilities.

e.

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.

ASTM-A370

:

Test Method and Definitions for Mechanical Testing of Steel Products.

h.

MSS-SP-75

:

Specification for High Test Wrought Welding Fittings.

i.


DNV-1981


:

Det Norske Veritas Rules for submarine pipeline.

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

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<p>3.0 MATERIALS</p> <p>3.1 Materials for the pressure containing parts of the flow tees shall be as indicated in the Data Sheet. Other components shall be as per Manufacturers standard suitable for the service, which shall be subject to approval by Purchaser.</p> <p>3.2 Fully killed carbon steel shall be used in the manufacture of flow tees.</p> <p>3.3 Each heat of steel used for the manufacture of pressure containing parts of the flow tees shall have carbon equivalent not exceeding 0.40, based on check analysis calculated as per the following formula:</p> $CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$ <p>3.4 Charpy V-notch test shall be conducted at 10°C for each heat of steel used in manufacture of pressure containing parts of the flow tees. Test procedure shall conform to MSS-SP-75.</p> <p>The average absorbed impact energy value of three specimens of base metal, weld metal and HAZ shall be 29 Joules. Minimum impact value of any one specimen of the three specimens analysed as above shall not be less than 22 joules.</p> <p>In addition, the average shear area shall comply the requirements of MSS-SP-75.</p> <p>3.5 Transverse guided weld bend test shall be performed in accordance with the provisions of MSS-SP-75. The dimension "A" in guided bend test shall not exceed 4.0 times the nominal wall thickness and dimension "B" shall be equal to A+ 2t + 3.2 mm, where "t" is nominal thickness.</p> <p>3.6 One transverse weld tensile test shall be conducted on each heat / lot of welded fittings in accordance with the requirements of MSS-SP-75.</p>				
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4.0

DESIGN AND CONSTRUCTION

4.1

Flow tees shall be designed and manufactured in accordance with the provisions of Codes and Standards referred in clause 2.0 of this specification. Design shall take into account the allowable stress level limits, design factor and corrosion allowance indicated in the Data Sheet.

4.2

Flow tees shall generally conform to the figure shown in the Data Sheet and shall meet the following requirements:

a.

An internal pipe having the same internal diameter of the connecting pipeline allowing the passage of scraper / instrumented pigs shall be provided with holes / slots located in the centre line of the branch. The holes shall be sized to prevent the pig getting stuck or damaged without affecting the flow through the branch line.

b.

A seamless / submerged arc welded extruded "tee" enclosing the internal pipe, fixed to it by suitably shaped forged steel rings. Machined steel rings shall not be used.

4.3

Stub-in or pipe to pipe connection shall not be used in the manufacture of flow tees. Flow tees shall be manufactured by forging or extrusion methods only. In case flow tees are manufactured using welded tees, the longitudinal weld seam shall be atleast 90⁰ to the extrusion.


4.4


Tees used for fabrication of flow tees shall be seamless type for run sizes ≤ 16" NB and shall be either welded or seamless type for run sizes ≥ 18" NB. Fittings shall conform to MSS-SP-75.

4.5

The flow tees run/branch diameter and wall thickness shall be as indicated in the Data Sheet, matching with the connecting pipeline.

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<p>4.6 Butt weld ends of flow tees shall have ends prepared as per MSS-SP-75.</p> <p>4.7. All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.</p> <p>4.8 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Sec. IX. The procedure qualification shall include impact test for weld/heat affected zone, and guided bend test complying the requirements of clause 3.4 and 3.5 of this specification respectively. Previously qualified procedures meeting the above requirements are acceptable.</p> <p>4.9 Repair by welding on parent metal of the flow tee is not allowed. Repair of weld seam by welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests which are applicable for regular production welding procedure qualification.</p> <p>5.0 INSPECTION AND TESTS</p> <p>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 inspections and tests shall be, but not limited to, the followings:</p> <p>5.1.1 All flow tees shall be visually inspected.</p> <p>5.1.2 Dimensional check shall be carried out as per the approved drawings.</p> <p>5.1.3 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.</p> <p>5.1.4 Non-destructive inspection shall be carried out on flow tees as given below:</p> <p>a. 100% inspection by radiography shall be carried out on all butt welds of pressure containing parts. Acceptance limits shall be as per API 1104.</p>				
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b. All finished wrought weld ends shall be 100% ultrasonically inspected for lamination type defects for a distance of 50mm from the end. Laminations shall not be acceptable.

c. Magnetic particle or liquid penetrant examination shall be performed on cold formed butt welding tees with extruded outlets, that are subjected to an extreme fiber elongation of greater than 5% shall be carried out as per the Supplementary Requirement SR 3 of MSS-SP-75.

d. Welds which 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.

5.1.5 Hydrostatic test shall be conducted for all flow tees complete in all respects, at a pressure equal to 1.5 times the design pressure indicated in the Data Sheet. Test pressure shall be held for a minimum period of 15 minutes.

5.2 Company's Inspector reserves the right to perform stagewise inspection and witness tests, as indicated in clause 5.1 of this specification 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, to the Company's Inspector.


Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.


6.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

a. Test certificates relevant to the chemical and mechanical properties of the materials used for manufacture of flow tees as per relevant standards and this specification.

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<div>b. Test reports of radiography, ultrasonic inspection and magnetic particle examination.</div> <div>c. Test reports of heat treatment carried out as per the specification.</div> <div>d. Welding procedures and welders qualification reports.</div> <div>e. Certificates for each tee used in the manufacture of flow tees stating that it is capable of withstanding without leakage a test pressure which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the flow tee is to be attached, without impairment of serviceability.</div> <div>7.0 PAINTING, MARKING AND SHIPMENT</div> <div>7.1 After all inspection and tests required have been carried out, all external surfaces shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with standard mill coating for protection against corrosion during transit and storage. The coating shall be easily removable in the field. Manufacturer shall furnish the details of paint used at the time of bidding.</div> <div>7.2 Ends of flow tees shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for flow tees.</div> <div>7.3 Flow tees shall be marked with indelible paint with the following:<div>a. Manufacturer's Name</div><div>b. Nominal diameter of run and branch</div><div>c. Nominal thickness of run and branch</div><div>d. Material</div></div>				
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8.0 DOCUMENTATION

8.1 Manufacturer shall furnish at the time of bidding, the following documents:

- a. General arrangement drawing of flow tees with Overall dimensions.
- b. Reference list of similar supplies including all relevant details viz. Project, Year, Client, Location, Size and Service.
- c. Record of successful proof test of tees in compliance with the requirement of cl. 9.0 of this specification.
- d. Brief description of the manufacturing, heat treatment and quality control facilities of the Manufacturer's Works.
- e. Clausewise list of deviations from this specification, if any.


8.2 Within three weeks of placement of order, the Manufacturer shall submit four copies, of, but not limited to, the following drawings, documents and specifications for approval :


- a. Fabrication drawing and relevant calculations for end rings according to the relevant codes.
- b. Calculation for the hole/slot size and flow area.
- c. Welding procedures and method of manufacture.

Once the approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing of all changes shall be obtained before the flow tees are manufactured.


8.3 Within four weeks from the approval data, Manufacturer shall submit six copies of all approved drawings, documents/specifications and one reproducible of all approved drawings as listed tin clause 8.2 of this specification.

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<p>8.4 Prior to shipment, the Manufacturer shall submit six copies of the test certificates as listed in clause 6.0 of this specification.</p> <p>8.5 All documents shall be in English Language only.</p> <p>9.0 MANUFACTURER'S QUALIFICATION</p> <p>Manufacturers who intend to bid for flow tees must possess the records of a successful proof test for tees used in the fabrication of flow tees, in accordance with the provisions of ANSI B-16.9/MSS-SP-75 as applicable. These records shall be submitted at the time of bidding qualifying the entire range of fittings offered. Failure to submit such records shall cause rejection of the offer.</p>				
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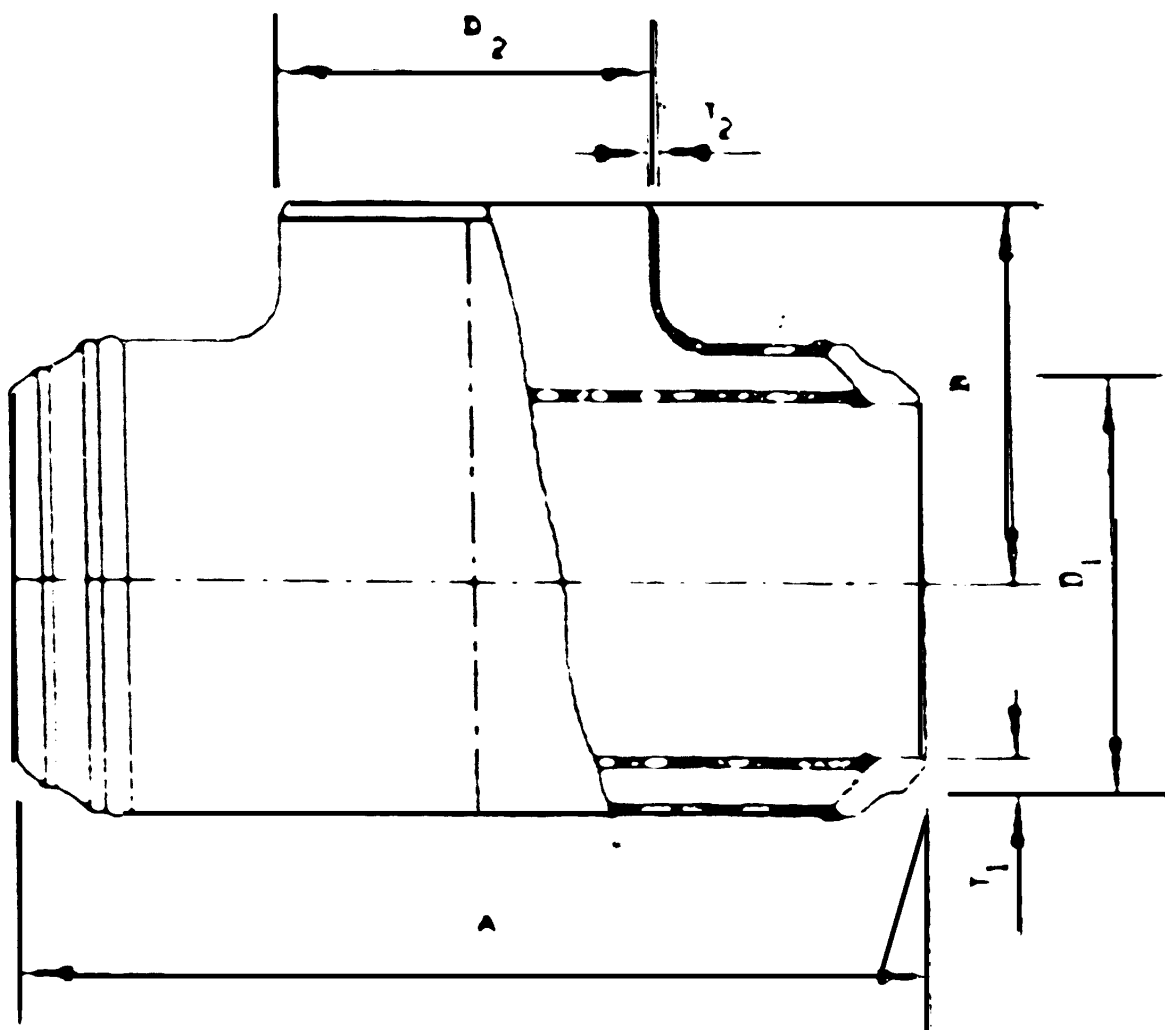
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<u>DATA SHEET</u>						
1.	Manufacturer		:			
2.	Company Specification No.		:	2028 A		
3.	Design / Service Conditions		:			
	Design Pressure		:			
	Design Temperature		:			
	Design Code		:			
	Design Factor		:			
	Service		:			
	Corrosion Allowance		:			
	ANSI Rating		:			
	Class		:			
	Installation Water Depth		:			
4.	Pipeline Details		:			
	Dia (NB)		:			
	Thickness		:	*		
	Material		:			
	Tag No.		:			
5.	Material Specification		:			
	Tee		:			
	End piece / rings		:			
	Internal Pipe		:			
6.	Flow Tee Details		:			
	Sl. No.	Size (OD) in inches		Quantity	Wall Thickness in mm	
		Header (D1)	Branch (D2)		Header (T1)	Branch (T2)
				No.	*	*

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				No.	*	*
7.	Others			:		
	a.	Manufacturer to indicate the dimensions marked "A" & "B" in figure on Sheet 2 of 2 and the details of the holed in the internal pipe.				
	b.	* Wall thickness shall be as per relevant Piping Material Specification.				

Figure
(sheet 2 of 2)



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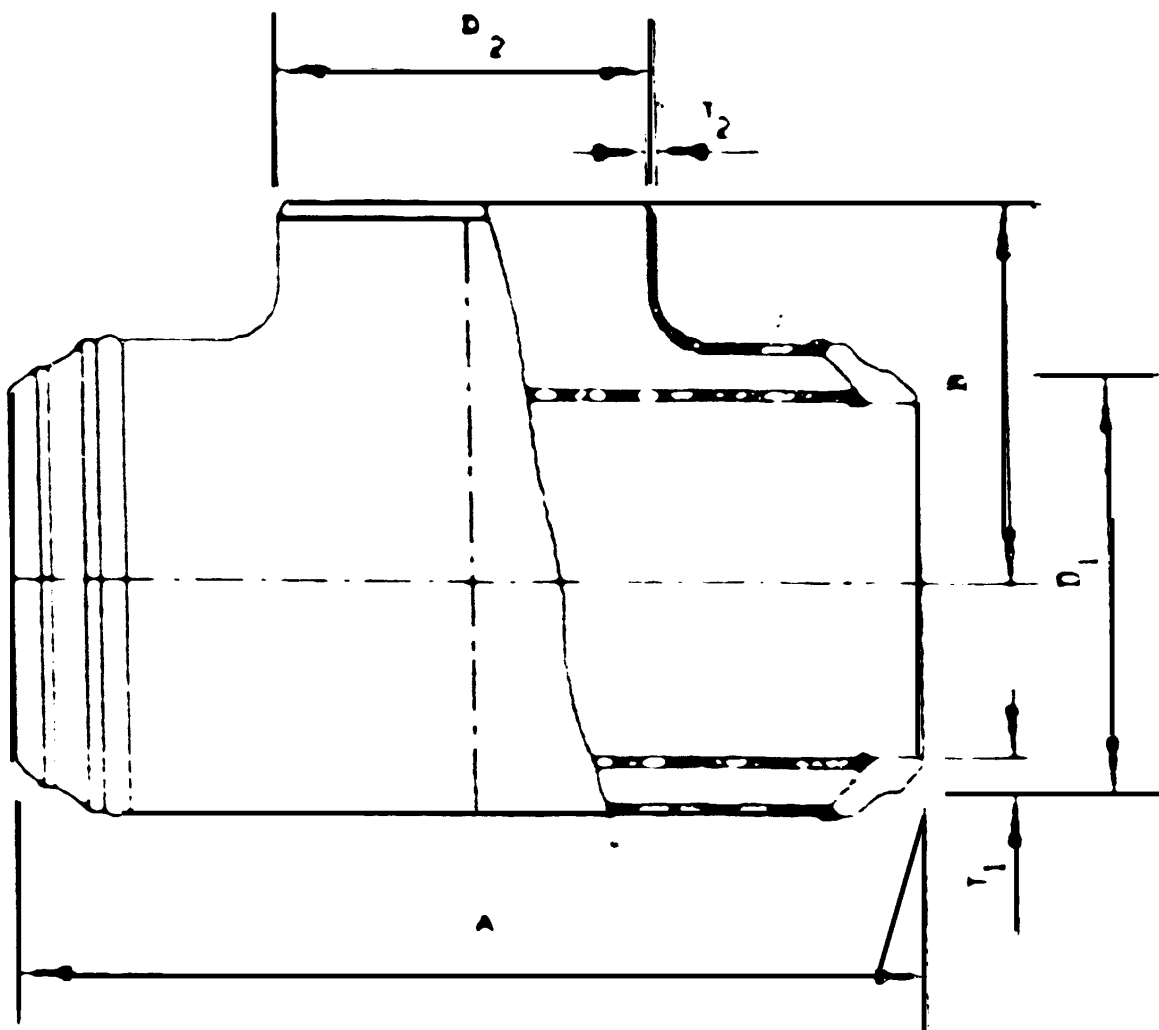
 Engineering & Projects Excellence Center ISO – 9001:2015	DATA SHEET FOR SUBSEA FLOW TEE (NON-SOUR SERVICE) DS-SSTEE-PRP-X	Spec. No.	2028A-DS-SSTEE--PRP-X
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1. **Manufacturer** :
2. **Company Specification No.** : 2028A
3. **Design/Service Conditions** :
 - a. Design Pressure : Refer Process Design Criteria
 - b. Design Temperature : Refer Process Design Criteria
 - c. Design Code : ASME 31.8/ ASME 31.4 / Boiler & Pressure Vessel Code
 - d. Service : Water Injection
 - e. Corrosion Allowance : 6.0 mm
 - f. ANSI Rating : #1500
 - g. Installation water depth : 100 m
4. **Pipeline Details:**
 - a. Size (Nominal) : 10" x 6" x 10" (Piggable)
 - b. Thickness : As per design by the Contractor (for Zone-2 pipe)
 - c. Material : API 5L Gr X-52 (Non NACE)
5. **Material Specification (or Equivalent/Superior)**
 - a. Tee : ASTM A 694 Gr F-52 Non NACE
 - b. End piece/rings : ASTM A 694 Gr F-52 Non NACE
 - c. Internal Pipe : API 5L Gr X-52 (Non NACE)
6. **Flow Tee Details:**


Sl. No.	Pipeline Segment	Size	Class	Quantity	Wall Thickness of run pipe & grade
1	10"WI BCPA2-VSEA to VSEC	10" X 6" X 10"	#1500	1	API 5L Gr X-52 (Non NACE)


7. **Others:**
Manufacturer to indicate the dimensions marked "A" & "B" in figure on Sheet 2 of 2 and the details of the holes in the internal pipe.
Area of the holes on the internal pipes: Minimum 1.1 times of internal area of branch connection (Calculation shall be submitted in support of the same).


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H.N.	T.M.K.	S.C.	Issued for Bid	2	22.04.2026	0
Prepared By	Reviewed By	Approved By	Remarks	No. of Pages	Date	Rev.

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<p>OIL AND NATURAL GAS CORPORATION LTD.</p> <p>INDIA</p>						
RP	AKS	VKK	Reproduced from Rev. 0	10+3	13.03.06	0
KPV		VKK	ISSUED FOR BID	10 + 3	09.05.03	0
Prepared by	Reviewed by	Approved by	REMARKS	NO. OF PAGES	DATE	REV.
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1.0

SCOPE

1.1

This Specification covers the minimum requirements for Design, Manufacture and supply of carbon steel flow tees to be installed in submarine pipeline systems transporting sour hydrocarbons in liquid or gaseous phase.

2.0

REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition of the following Codes, Standards & Specifications:

a.

ASME B-31.8

:

Gas Transmission and Distribution piping Systems.

b.

ASME B-31.4

:

Liquid Petroleum Transportation Piping Systems.

c.

ANSI-B-16.9

:

Factory Made Wrought Steel Butt Welding Fittings.

d.

API-1104

:

Specification for Welding of Pipelines and Related Facilities.

e.

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.

ASTM-A370

:

Test Method and Definitions for Mechanical Testing of Steel Products.

h.

MSS-SP-75

:

Specification for High Test Wrought Welding Fittings.

i.

DNV-1981


:

Det Norske Veritas Rules for submarine pipeline.

j.

NACE Standard MR-01-75

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3.0

MATERIALS

3.1

All materials exposed to sour environment shall comply to the requirements of NACE Standard MR-01-75. All sour service material shall meet special testing viz. HIC (as per NACE MR 0177) and inclusion count check (as per ASTM E 45) Materials for the pressure containing parts of the flow tees shall be as indicated in the Data Sheet. Other components shall be as per Manufacturer's standard suitable for the service, which shall be subject to approval by Purchaser.

3.2

Each heat of steel used for the manufacture of pressure containing parts of the flow tees shall have carbon equivalent not exceeding 0.40, based on check analysis calculated as per the following formula:

CE = C +

Mn

6

+

Cr+Mo+V

5

+

Ni+Cu

15


3.3

Charpy V-notch test shall be conducted at 0°C for each heat of steel used in manufacture of pressure containing parts of the flow tees. Test procedure shall conform to MSS-SP-75.

The average absorbed impact energy value of three specimens of base metal, weld metal and HAZ shall be 29 Joules. Minimum impact value of any one specimen of the three specimens analysed as above shall not be less than 22 joules.

In addition, the average shear area shall comply the requirements of MSS-SP-75.

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3.4

Transverse guided weld bend test shall be performed in accordance with the provisions of MSS-SP-75. The dimension "A" in guided bend test shall not exceed 4.0 times the nominal wall thickness and dimension "B" shall be equal to $A + 2t + 3.2$ mm, where "t" is nominal thickness.

3.5

One transverse weld tensile test shall be conducted on each heat / lot of welded fittings in accordance with the requirements of MSS-SP-75.

4.0

DESIGN AND CONSTRUCTION

4.1

Flow tees shall be designed and manufactured in accordance with the provisions of Codes and Standards referred in clause 2.0 of this specification. Design shall take into account the allowable stress level limits, design factor and corrosion allowance indicated in the Data Sheet.

4.2

Flow tees shall generally conform to the figure shown in the Data Sheet and shall meet the following requirements:

a.

An internal pipe having the same internal diameter of the connecting pipeline allowing the passage of scraper / instrumented pigs shall be provided with holes / slots located in the centre line of the branch. The holes shall be sized to prevent the pig getting stuck or damaged without affecting the flow through the branch line.


b.

A seamless / submerged arc welded extruded "tee" enclosing the internal pipe, fixed to it by suitably shaped forged steel rings. Machined steel rings shall not be used.

4.3

Stub-in or pipe to pipe connection shall not be used in the manufacture of flow tees. Flow tees shall be manufactured by forging or extrusion methods only.

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In case flow tees are manufactured using welded tees, the longitudinal weld seam shall be atleast 90⁰ to the extrusion.

4.4 Tees used for fabrication of flow tees shall be seamless type for run sizes ≤ 16" NB and shall be either welded or seamless type for run sizes ≥ 18" NB. Fittings shall conform to MSS-SP-75.

4.5 The flow tees run/branch diameter and wall thickness shall be as indicated in the Data Sheet, matching with the connecting pipeline.

4.6 Butt weld ends of flow tees shall have ends prepared as per MSS-SP-75.

4.7. All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.


4.8 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Sec. IX. The procedure qualification shall include impact test for weld/heat affected zone, and guided bend test complying the requirements of clause 3.3 and 3.4 of this specification respectively. Previously qualified procedures meeting the above requirements are acceptable.


4.9 Repair by welding on parent metal of the flow tee is not allowed. Repair of weld seam by welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests which are applicable for regular production welding procedure qualification.


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 inspections and tests shall be, but not limited to, the followings:

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<p>5.1.1 All flow tees shall be visually inspected.</p> <p>5.1.2 Dimensional check shall be carried out as per the approved drawings.</p> <p>5.1.3 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.</p> <p>5.1.4 Non-destructive inspection shall be carried out on flow tees as given below:</p> <p>a. 100% inspection by radiography shall be carried out on all butt welds of pressure containing parts. Acceptance limits shall be as per API 1104.</p> <p>b. All finished wrought weld ends shall be 100% ultrasonically inspected for lamination type defects for a distance of 50mm from the end. Laminations shall not be acceptable.</p> <p>c. Magnetic particle or liquid penetrant examination shall be performed on cold formed butt welding tees with extruded outlets, that are subjected to an extreme fiber elongation of greater than 5% shall be carried out as per the Supplementary Requirement SR 3 of MSS-SP-75.</p> <p>d. Welds which 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.</p> <p>5.1.5 Hydrostatic test shall be conducted for all flow tees complete in all respects, at a pressure equal to 1.5 times the design pressure indicated in the Data Sheet. Test pressure shall be held for a minimum period of 15 minutes.</p> <p>5.2 Company's Inspector reserves the right to perform stagewise inspection and witness tests, as indicated in clause 5.1 of this specification at Manufacturer's</p>				
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<p>Works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector.</p> <p>Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.</p> <p>6.0 TEST CERTIFICATES</p> <p>Manufacturer shall furnish the following certificates:</p> <ul style="list-style-type: none">a. Test certificates relevant to the chemical and mechanical properties of the materials used for manufacture of flow tees as per relevant standards and this specification.b. Test reports of radiography, ultrasonic inspection and magnetic particle examination.c. Test reports of heat treatment carried out as per the specification.d. Welding procedures and welders qualification reports.e. Certificates for each tee used in the manufacture of flow tees stating that it is capable of withstanding without leakage a test pressure which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the flow tee is to be attached, without impairment of serviceability. <p>7.0 PAINTING, MARKING AND SHIPMENT</p> <p>7.1 Painting shall be done in accordance to the “General Specification for Protective Coating Spec. No. 2005”.</p>				
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<p>7.2 Ends of flow tees shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for flow tees.</p> <p>7.3 Flow tees shall be marked with indelible paint with the following:</p> <ul style="list-style-type: none">a. Manufacturer's Nameb. Nominal diameter of run and branchc. Nominal thickness of run and branchd. Material <p>8.0 DOCUMENTATION</p> <p>8.1 Manufacturer shall furnish at the time of bidding, the following documents:</p> <ul style="list-style-type: none">a. General arrangement drawing of flow tees with Overall dimensions.b. Reference list of similar supplies including all relevant details viz. Project, Year, Client, Location, Size and Service.c. Record of successful proof test of tees in compliance with the requirement of cl. 9.0 of this specification.d. Brief description of the manufacturing, heat treatment and quality control facilities of the Manufacturer's Works.e. Clausewise list of deviations from this specification, if any.				
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8.2

Within three weeks of placement of order, the Manufacturer shall submit four copies, of, but not limited to, the following drawings, documents and specifications for approval :

a.

Fabrication drawing and relevant calculations for end rings according to the relevant codes.

b.

Calculation for the hole/slot size and flow area.

d.

Welding procedures and method of manufacture.

Once the approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing of all changes shall be obtained before the flow tees are manufactured.

8.3

Within four weeks from the approval data, Manufacturer shall submit six copies of all approved drawings, documents/specifications and one reproducible of all approved drawings as listed in clause 8.2 of this specification.

8.4

Prior to shipment, the Manufacturer shall submit six copies of the test certificates as listed in clause 6.0 of this specification.

8.5


All documents shall be in English Language only.

9.0

MANUFACTURER'S QUALIFICATION

Manufacturer who intend bidding for flow tees must possess the records of a successful proof test for tees used in the fabrication of flow tees, in accordance with the provisions of ANSI B-16.9/MSS-SP-75 as applicable.

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	OIL & GAS ENGINEERING AND PROJECTS ISO 9001:2015	DATA SHEET FOR SUBSEA FLOW TEE (SOUR SERVICE) DS-SSTEE-PRP-X	Spec. No.	2028B-DS- SSTEE-PRP-X
			Rev. No.	1
			Discipline	PIPELINE
			Page: 1 OF 2	

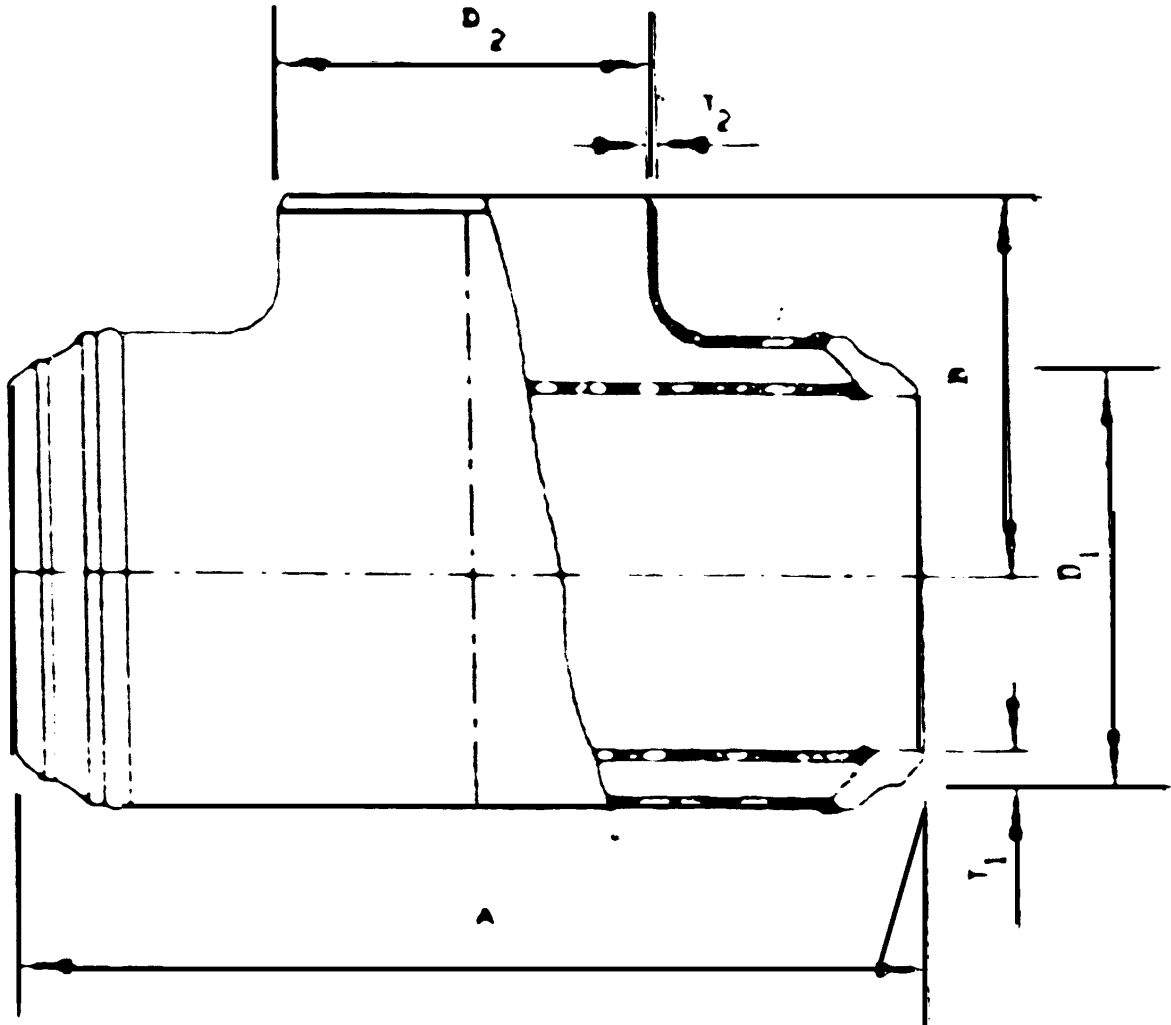
1. **Manufacturer** :
2. **Company Specification No.** : 2028B
3. **Design/Service Conditions** :
 - a. Design Pressure : Refer Process Design Criteria
 - b. Design Temperature : Refer Process Design Criteria
 - c. Design Code : ASME 31.8/ ASME 31.4 / Boiler & Pressure Vessel Code
 - d. Service : Well Fluid (Sour)
 - e. Corrosion Allowance : 6.0 mm
 - f. ANSI Rating : #1500
 - g. Installation water depth : 100 m
4. **Pipeline Details:**
 - a. Size (Nominal) : 8" x 8" x 8"
 - b. Thickness : As per design by the Contractor
 - c. Material : API 5L Gr X-60 (NACE)
5. **Material Specification (or Equivalent/Superior)**
 - a. Tee : ASTM A 694 Gr F-60 NACE
 - b. End piece/rings : ASTM A 694 Gr F-60 NACE
 - c. Internal Pipe : API 5L Gr X-60 (NACE)
6. **Flow Tee Details:**

Sl. No.	Pipeline Segment	Size	Class	Quantity	Wall Thickness of run pipe & grade
1	8" WF WO-16 to 30" ICP-Heera Tie in	8" x 8" x 8"	#1500	1	API 5L Gr X-60 (NACE)


7. **Others:**

Manufacturer to indicate the dimensions marked "A" & "B" in figure on Sheet 2 of 2 and the details of the holes in the internal pipe.
Area of the holes on the internal pipes: Minimum 1.1 times of internal area of branch connection
(Calculation shall be submitted in support of the same)

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OES/SOF/028		03	00	26.02.2018



H.N.	T.M.K.	S.C.	Issued for Bid	2	25.06.2025	0
Prepared By	Reviewed By	Approved By	Remarks	No. of Pages	Date	Rev.

	IMR Section, OLG 7 th Floor, 11-High Office Complex Bandra-Sion Link Road, Mumbai 400 017	Pipeline Repair Connectors (SPRUs) (Mechanical Actuation) for Sour Service (Well Fluid and Gas Lift) Data sheet no: DS-SPRU-PRP-VII- RTR
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1. **Scope of supply:**

1.1. **Connectors**

S.No	Nominal Pipe dia (inches)	Connector description	Qty
1	Refer Table 4.2 of Annexure to Section 4A (Part I)	Mechanically actuated pipeline repair connectors for sour service with MAF designed to pressure rating corresponding to ANSI 1500 class / 900 class (Refer Table 4.2 of Annexure to Section 4A (Part I)), with 100 m water depth in N ₂ / inert gas fillable cylindrical steel containers, complete with accessories.	Refer Table 4.2 of Annexure to Section 4A (Part I)

1.2. **Accessories required with each size of connector:**

S.No	Item	Qty
1	Bolt tensioning set having number of stud tensioners equal to number of studs of connector with accessories including whips, Tee blocks, etc necessary for 100% actuation of connector in single operation	1 Set
2	Bolt tensioning set having number of stud tensioners equal to number of studs of MAF with accessories including whips, Tee blocks, etc necessary for 100% actuation of MAF in single operation.	1 Set
3	Spare repair kit for Bolt tensioners mentioned at S.No.1 above	4 Sets
4	Spare repair kit for Bolt tensioners mentioned at S.No.2 above	4 Sets
5	One spare set of stud with 2 nuts on for each connector	1 Set
6	One spare set of stud with 2 nuts on for each MAF	1 Set
7	Spare seal ring set for each MAF	2 Sets

Note:

- Items covered under scope of supply should be of recent manufacture, of first quality and not more than one year old at the time of delivery. This should be supported with manufacturer's certificate and certified by TPI as mentioned at 6.1 (Inspection and Certification).
Whether SPRU's Connector and MAF part comprises of same sized studs or it is a single actuation type SPRU, separate set of bolt tensioners (equal to number of studs of Connector and MAF) to be supplied.

2. **Technical Specifications:**

This document describes the requirement of repair connectors required for effecting repairs to underwater pipeline so as to install the repair connector with bare metal pipe without any hyperbaric (underwater) welding and without lifting pipeline above the sea level.

A repair connector shall comprise of following items:

A. **Coupling**

A sleeve, that structurally attaches to and seals off bare ended pipes by its internal grips. This coupling should have seals for sealing the annular space between the outer surface of the pipeline and inner surface of the coupling.

B. **Misalignment Flange (MAF)**

For connecting the spool piece with coupling and having seal integrity up to +/- 10 Degree of misalignment in any axial plane from the centerline of the adjoining pipeline.

3. **Details of Pipelines and Service Conditions**

3.1. **Details of Pipeline**

Nominal diameter (inches)	WALL THICKNESS (IN MM)	GRADE OF LINE
Refer Table 4.2 of Annexure to Section 4A (Part I)	Refer Table 4.2 of Annexure to Section 4A (Part I)	Refer Table 4.2 of Annexure to Section 4A (Part I)

3.2. **Service Conditions**

3.2.1. Fluid: Crude Oil, Natural Gas, Formation/Sea Water.

3.2.2. Temp. Range: 17 Deg. Celsius - 100 Deg. Celsius.

3.2.3. Offered connector should be suitable for sour service conditions as per NACE MR-01-75 (latest edition) requirements.

3.2.4. Water Depth: Up to 100 m.

The repair connector can be used on any of the pipeline or on their riser depending upon requirement.

4. Technical Features

Each Repair Connector should have features as stipulated below and comply with the following technical specifications.

- 4.1. **Weld-less connection with the pipeline:** Coupling should provide gripping and sealing over the bare pipeline and a misalignment flanged end for connecting a spool piece/extension. The sealing shall be attained using high quality Fluro elastomers / graphite seals suitable for inventory in the pipeline.
- 4.2. **Structural Integrity:** The coupling should be able to withstand all axial, shear and bending loads. Bidder shall calculate the stress distribution in the pipeline caused by external seal/grip pressure to demonstrate that pipeline (details specified in cl.3.1) is safe under such loading in cold condition when there is no pressure in the line.
- 4.3. **Sealing:** Sealing integrity of the coupling should not be affected by temperature variations in the range of 17 degrees Centigrade to 100 degrees Centigrade.
- 4.4. **Test of sealing of coupling:**
 - 4.4.1. The coupling should have a test port & bleed port to test the sealing after the installation of repair connector but before charging the line. The test port should be fitted with requisite fittings which should finally terminate with $\frac{1}{4}$ " BSP male quick disconnect coupling and matching $\frac{1}{4}$ " BSP female quick disconnect coupling fitted with $\frac{1}{4}$ " BSP [male] X $\frac{1}{4}$ " BSP [Male] adapter to be supplied as loose item.
 - 4.4.2. The bleed port should be fitted with a suitable bleeder valve cum plug.
 - 4.4.3. The pressure testing should be achieved without internally pressurizing the pipeline.
 - 4.4.4. The drawing of the connector indicating test port & bleed port in support of 4.4.1 above and a write up explaining the seal test feature in support of 4.2.3 above should be submitted along with the bid. All drawings should be supplemented with bill of materials.
- 4.5. **Actuation for gripping and sealing:** The gripping and sealing should be achieved by the following method:
 - 4.5.1. Uniform actuation of gripping and sealing in single operation by means of bolt tensioning through hydraulically operated bolt tensioners suitably interconnected for simultaneous actuation through a single hydraulic power fluid connection. To achieve this, number of tensioners and their sizes, adaptors, connectors etc. required, are to be specified and provided for repair of connector and MAF.
 - 4.5.2. The total tensioning system to be suitably designed and to be compatible with our available power pack of 20,000 PSI (maximum pressure rating) with $\frac{1}{4}$ " BSP end connection for hose. Accordingly, the bidder should indicate the maximum hydraulic pressure and flow rate required to achieve gripping and sealing and/or testing.
 - 4.5.3. An explanation on design features supported with technical drawing/graphics in support of above should be submitted with the bid.
 - 4.5.4. The bidder should furnish details of type/model of stud tensioners & hydraulic Pressure applied to stud tensioners for setting.
- 4.6. **Length Compensation for end adjustment**
 - 4.6.1. Each coupling should have built in feature of length compensation i.e. for end adjustment covering minimum length equal to ONE DIAMETER of pipeline. This may be achieved either by telescoping feature of coupling or through a length compensation joint forming integral part of coupling or any other method. It should not involve any welding of separate items by user to achieve the above feature.
 - 4.6.2. The above feature 4.6.1 should be explained by drawing and write up and same should be submitted with the bid.
- 4.7. **Provision to take care of misalignment, Misalignment Flange (MAF)**
 - 4.7.1. The repair connector should have provision to take care of misalignment up to +/- 10 deg. in any plane from the center line axis. One part of 'MAF' should be attached to coupling with counterpart of 'MAF' bolted to this part. Sealing integrity is to be maintained at all angles of misalignment within above specified limit.
 - 4.7.2. In support of satisfying the feature 4.7.1 above, drawing and write up should be submitted along with the bid.
- 4.8. **Test of Sealing of Misalignment Flange (MAF)**
 - 4.8.1. The 'MAF' should have test port for hydrostatic testing for metal to metal seal verification without pressurizing/commissioning the pipeline.
 - 4.8.2. The MAF should have bleed port for checking the continuity of hydraulic fluid inside the sealing area.
 - 4.8.3. In support of satisfying the feature 4.8.1 & 2 above, drawing and write up should be submitted along with the bid.
- 4.9. **Test pressure**
 - 4.9.1. All pressure tests shall be carried out to satisfy ANSI Class 1500 requirements.
 - 4.9.2. Each test port of the coupling and MAF should be fitted (when Connector is supplied) with a suitable connection for connecting a high pressure hose including mating adaptors compatible to $\frac{1}{4}$ " I.D. hose. The size and thread profile of connection should be indicated in the bid. All actuation, pressure testing, will be carried out / witnessed from the deck of the vessel only.
 - 4.9.3. The acceptance and compliance of 4.9.1 and 2 above should be given by the bidder in the technical bid.
- 4.10. The Repair Connector after installation should be **piggable**. Bidder should confirm suitability of Repair

- Connector for this purpose in the technical bid.
- 4.11. **Sacrificial Anode:** Each repair connector should be supplied fitted with zinc or galvalum anode sized for a minimum life of 25 years
- 4.12. The **studs of MAF** should be long enough to accommodate hydraulic bolt tensioning device. A confirmation to this effect should be given in the bid.
- 5. Material specifications**
- 5.1. Coupling and MAF:
ASTM-A-350 Gr.LF2/ASTM-A-694/ASTM-A-516/ASTM A-675 Gr.70 with NACE MR-01-75 (latest edition) requirements.
- 5.2. Bolts: ASTM-A-193-B7M; Nuts: ASTM-A194-Gr.2M PTFE coated.
(In case of better/improved material specifications/physical properties, details of the same should be submitted and ONGC's decision regarding superiority or otherwise will be final.)
- 5.3. For corrosion protection from outside, white epoxy marine paint shall be applied in 3 layers to a thickness of 0.015 inches.
- 5.4. Other non-metal parts in the repair connectors such as Elastomers etc. shall be selected based on line fluid service conditions as stipulated in clause 3.2.
- 5.5. The repair connector shall be designed with corrosion allowance for 25 years.
- 5.6. Bidder shall furnish sectional drawing of connector and 'MAF' showing parts with reference numbers and bill of materials.
- 6. Inspection & Certification**
- 6.1. Inspection should be done keeping in view requirements indicated in API 6H (latest edition) and conditions of purchase order. The test certificates and quality assurance inspection reports should be provided for each connector with accessories, along with the supply. The supply order no & date, **year of manufacture of items** must be mentioned in the third party inspection certificate.
- 6.2. Third party inspection of all above items shall be arranged by supplier through any of the following Third Party Inspection agencies (TPI) like DNV, LRS, BV.
- 6.3. Cost of inspection and certification shall be borne by supplier and should be included in the connector rate. No separate inspection cost should be indicated
- 6.4. Acceptance /compliance for above should be given with the bid.
- 7. Packing**
- 7.1. Each Repair Connector shall be supplied in a Steel Container fillable with Nitrogen or any other Inert Gas, at 10 psi. Each container shall carry Identification Number and Packing List details duly written in bold letters at prominent location on the container's outer surface. The containers are to be of cylindrical shape with opening from one end only for proper sealing. Its edge must have groove for housing the seal and it should be tested at 15 psi for one hour. Pressure gauge and inert gas charging arrangement with valve should be fitted on flat face of each container. All these fittings should have protection guard to avoid any damage during handling. The container should have at least two stands welded to the container at suitable locations at 6 o'clock position to avoid rolling of container during storage on vessel deck at sea. The container should have suitable lifting pad-eye / arrangement. Suitable arrangement should be provided so as to ease the process of pulling out the connectors from containers without damage.
- 7.2. On receipt of connectors at stores, the canisters are to be pressurized with Nitrogen/inert gas to 10psi, by the supplier, within 30 days of delivery.
- 7.3. One set of following documents should be supplied along with the consignment inside the container:
- 7.3.1. Installation procedure.
- 7.3.2. As built drawing with bill of material
- 7.3.3. Details of stud tensioners / accessories & its manual.
- 7.3.4. The design features & technical data to satisfy sealing features mentioned at 4.3 to 4.5 above.
- 7.4. Other items will be suitably marked and packed for sea transportation.
- 7.5. Items such as studs/O-rings/nuts etc. should not be packed inside the canister for connector.
- 7.6. The acceptance/compliance of above should be given in bid.
- 8. General Conditions**
- 8.1. Manufacturer should supply/provide spare parts/service & technical support, for the ordered products, in future on the request of ONGC.

SBD	SK	AKM	ISSUED FOR BID	3	22.07.2021
PREPARED BY	REVIEWED BY	APPROVED BY	REMARKS	NO. OF PAGES	DATE

Vendors for connectors (SPRUs):		
Sr.No.	Vendor	Indian Representative
1	<p>Oceaneering International. Inc. (400914) Pipeline Connection & Repair Systems (PCRS) 111911 FM 529, Houston, TX 77041 Phone: 713.329.4500 Fax: 713.329.4965 email: PCRS@oceaneering.com www.oceaneering.com Worldwide Sales John Charalambides – General Manager, PCRS Direct +1 (713) 329-4962 Cell +1 (832) 368-4543 JChara@oceaneering.com</p> <p>Al Cooper - Sales & Marketing Manager Direct +1 (713) 329-4969 Cell +1 (713) 828-6708 ACooper@oceaneering.com</p> <p>William Moya - Inside Sales & Proposals Manager Direct +1 (713) 329-4963 Cell +1 (832) 725-6814 WMoya@oceaneering.com</p>	<p>Interocean Oil Services 102, glen Eagle, Plot No 7, Gulmohar Road, JVPD Scheme, vile Parle (W), Mumbai 400049 Mr Mahesh Valia, Managing Partner 9820067470 26209689/26209672 F: 26209688 email: vbplnp@yahoo.co.in</p>
2	<p>Subsea Innovation Limited 3 Roundhouse Road, Faverdale East Business Park, Darlington DL3 0UR, United Kingdom Tel: +44(0) 1325 385270 Fax: +44(0) 1325 385285 info@subsea.co.uk</p>	<p>Libra International Aleb 101, Manar Silver Shadows 2-1/A, Kasavana Halli, Carmelram Post Off sarjapura Road, Bangalore 560035 9739098804 918042129196 vishy@libraint.com www.libraint.com</p>
3	<p>Hydratight (406102) Bentley Road South Darlaston, West Middlelands England Tel: 0121 505 0600, Fax: 0121 505 0800 www.hydratight.com</p> <p>Hydratight Ltd Nr 1A, Peenya Industrial Area 2nd phase Bangalore-560 058 India Tel: +91-99027-83547 Email: india@hydratight.com Murali Narasimhan, country leader-India murali.narasimhan@hydratight.com</p>	<p>Oiltech Consultancy Services 11/12, Veena Beena, Gurunanak road, Bandra (W), Mumbai 400050 9820070012 66936500 Fax: 26514429 ashish@oiltechconsultancy.com rajesh@oiltechconsultancy.com</p>

4	<p>Proprietary Oilfield Products Oil States Industries, Inc. P. O. Box 670 Arlington, Texas 76004-0670 7501 South Cooper Street Arlington, Texas 76001 Tel. +1 817 548 4200 Fax. +1 817 548 4252 pop@oilstates.com betty.mccrory@oilstates.com bonnie.taylor@oilstates.com</p>	<p>Results Marine RPT House, 3rd Floor, Plot No 6, Sector 24, Vashi, Navi Mumbai – 400703 (022) 27845404 /05/06/07/08 9833955507 avinash@resultsmarine.com Avinash K Tiwari, Senior Manager, Business Dev, Oil & Gas</p>
5	<p>M/s Middle East Onshore & Offshore Oil & Gas Equipment FZE quoted for the SPRUs manufactured by: M/s Shidarian Kish Ltd. No.33, Industrial complex No.5, Kish Island-IRAN Tel:+98 764-4426065-6 Fax:+98 764-4426067 Email: info@shidarian.com WWW.SHIDARIAN.COM</p>	
6	<p>M/s CONNECTOR AS, NORWAY Kokstadflaten 17, 5257 Kokstad Bergen, Norway- 1201 Tel:+44 777 2384 128 Fax:+47 99 701 111</p>	<p>MR NITIN PATEL Nitin.patel@connectorsubsea.com</p>
7	<p>M/S Vee Kay Vikram & Co LLP, D102, FF, Shivalik Business Center, Opp. Golf Academy, SG Highway Ahmedabad, Gujarat, 380054 Phone No. 079-40506111 Contact Person : Mrs. Nisha Suresh Cell No. : +91 9824030624 Email : tender@vkvc.com</p>	