PETROBRAS	TECHNICAL SPECIFICATION	Nr.:	I-ET-3903.06-6511-211-TUK-3295
	Client User:	E & P	Sheet: 1 OF 26
	Job or Unit:	PDET Profundo	C.C.
	Area or Unit	BACIA DE CAMPOS	
ENGENHARIA / IEEPT/IEDS	Title:	SPECIFICATION FOR SAW PIPE MANUFACTURE AND SUPPLY	

Technip OFFSHORE BRANCH TECHNIP OFFSHORE UK Ltd.	TUK Nr:	I-ET-3903.06-6511-211-TUK-3295	
	Contract Nr:	0801.0015453.05.2	
	Technical Resp.:	Name:	Initials:
	CREA Reg Nr:		

REVISION INDEX

REV.	DESCRIPTION AND / OR REVISED SHEETS
0	Original
A	Issued for DNV Comments a) According to Project Master Document Register - MDR_RB – Week 13, the document number changed from I-ET-3903.06-6511-211-TUK-3305 to I-ET-3903.06-6511-211-TUK-3295. b) Revised to include comments from ADP-EDI-608/2005 c) General Revision
B	Issued for DNV Approval – VerCom-001C comments included and revised according to BR Response to TQF-0045 1.0.addition.Introduction amended to include documentation hierarchy clarification 2.0 .addition. Full list of reference standards (and Project Specific Material Requisitions included) 5.2.2.1 5.3.2.addition.WFL+5mm Charpy Impacts required for SAW welded pipes 5.2.3. Amendment. Hardness values clarified. 5.2.2.2 .amendment. Section numbering revised. 5.3.2. Amendment. Impact testing requirements (reeled pipe only) modified. 8.6 additions…Clarification of Data Book requirements. 10.0 additions. New Section. Pipe Handling, Storage and Transportation. Appdx1.amendment reference to ERW pipe removed/Hardness acceptance criteria revised
C	Issue for Client (Re) Approval VerCom-001D Closed.
D	Issue for Client Approval Comments included and revised according to BR Response to TQF B51232-C-TUK-0082.
E	AFC – Approved for Construction (ADP-PDET-EDI-00011)

File Nr : I-ET-3903.06-6511-211-TUK-3295_RE

	ORIGINAL	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	06/10/05	30/11/05	03/01/06	11/01/06	02/03/06	20/06/06			
PROJECT	TUK	TUK	TUK	TUK	TUK	TUK			
EXECUTED	KNO/JDU	KNO/JDU	KNO/JDU	KNO/JDU	KNO	KNO			
CHECKED	ALA	ALA	ALA	ALA	JDU	JDU			
APPROVED	GST	GST	GST	GST	GST	GST			

INDEX

1 INTRODUCTION

1.1 Project Description

The PDET (Oil Flow Master Plan) project consists of the installation of an 18-inch oil export pipeline and of a Free Standing Hybrid Riser (FSHR) from the P52 Semi-submersible floating production unit (FPU) located in the Campos Basin, offshore Brazil.

Technip have been awarded by PETROBRAS the Engineering, Procurement, Construction, and Installation (EPCI) for the oil exportation system, from P52 FPU to a fixed platform PRA-1.

The base case for the export system consists of a vertical riser and an export pipeline. The riser is a Free Standing Hybrid Riser (FSHR) consisting of a vertical steel pipe tensioned by a near surface buoyancy with a flexible jumper (FJ) connecting the top of the riser and the FPU. The 1ARO-O18-01 export pipeline is approximately 56 km long, going from 1800m water depth at P52 up to 100m water depth at PRA-1 platform. Figure 1.1 presents the PDET schematic.

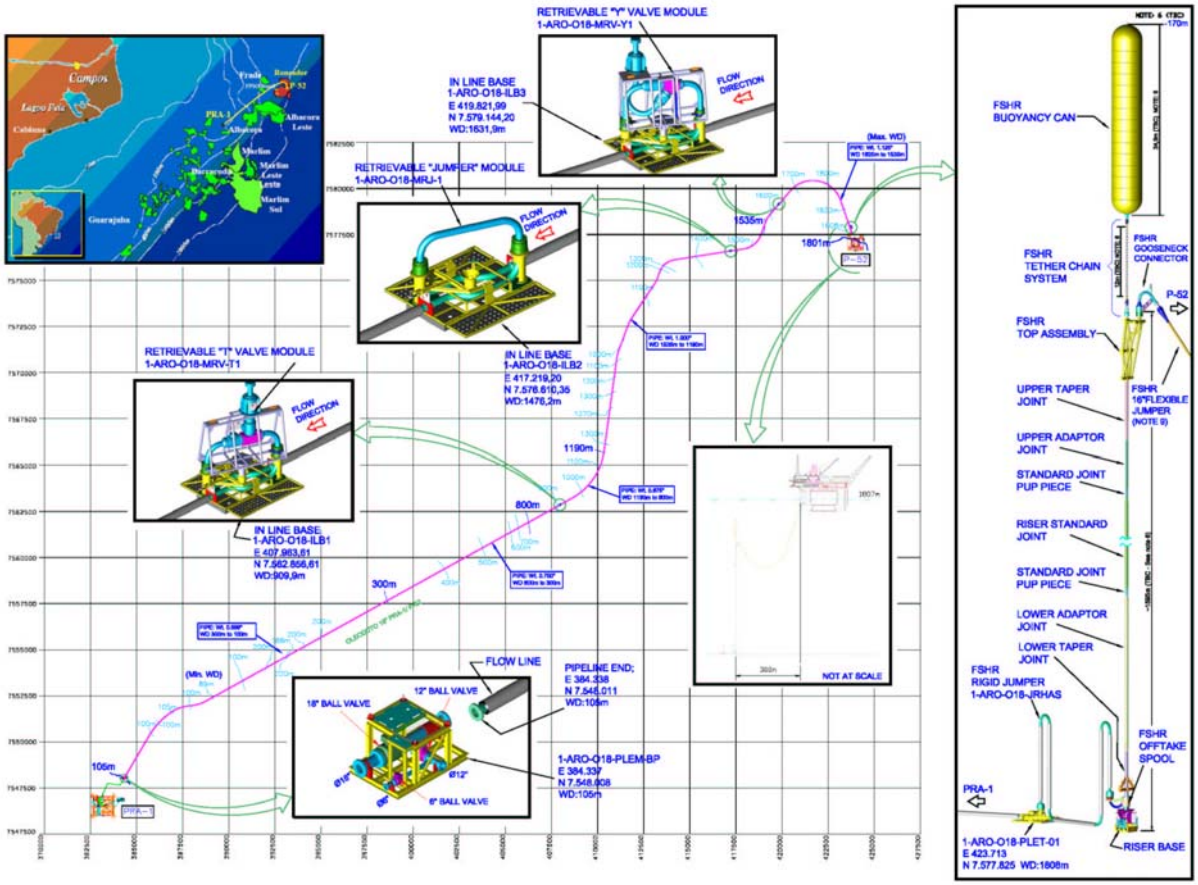


Figure 1.1

1.2 Document Description

The purpose of this document is to define PETROBRAS and TOUK's additional requirements for the procurement of C-Mn SAWL Line Pipe. This pipe shall be installed by the Reel or J-Lay process. Where the reel lay process is to be utilized this shall be specifically noted at time of order.

Pipes shall be in accordance with API 5L, DNV-OS-F101 and/or ISO 3183, plus the following changes, as noted in parenthesis for each clause, according the definitions stated below:

Addition - insertion of a new requirement or continuation of that API 5L paragraph;

Replacement - replacement of part or it entirely of that affected API 5L paragraph;

Deletion - removal of that particular API 5L paragraph.

Paragraphs of API 5L not mentioned herein are considered fully applicable.

In the event of dispute between API 5L and this document, this document shall apply.

The clauses in parenthesis referred to hereunder refer directly to API 5L.

All pipes shall be manufactured in accordance with DNV OS-F101, API 5L and/or ISO 3183, and the requirements stated herein. In case of conflicting requirements, the strictest requirement shall apply.

Should any areas of deviation from the manufacturing requirements of these National Standards, referenced above and those herein arise then this specification shall take precedence.

2 REFERENCE DOCUMENTS

2.1 International Standards

Ref Doc	Doc. Number	Title	Rev.
1	API 5L	Specification for Linepipe	43
2	DNV-OS-F101	Submarine Pipeline Systems	2000
3	ISO 3183-3	Steel Pipe for Pipelines	***1999***
4	ASNT-SNT-TC-1A	Personnel Qualifications and Certification in Non Destructive Testing	1984
5	BS709	Methods of destructive testing fusion welded joints and weld metal in steel	1983
6	BS EN ISO 6507	Metallic materials - Vickers hardness test - Part 1: Test method	1990
7	DIN EN 10160	Ultrasonic testing of steel flat product of thickness equal to or greater than 6 mm	1999
8	EEMUA 166:1991	Specification for Line Pipe for Offshore	1991
9	NACE TM-01-77	Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in Hydrogen Sulfide (H2S) Environments	1977
10	NACE TM-02-84	Standard Test Method - Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking	1984

2.2 Petrobras Documents

Ref Doc	Doc. Number	Title	Rev.
1	I-ET-3000.00-6500-200-PPR-005	Supplementary Requirements to API SPEC 5L	0
2	I-ET-3010.64-1500-274-HHO-502	C-Mn Steel Line Pipe	B

2.3 TOUK Documents

Ref Doc	Doc. Number	Title	Rev.
1	OED-TP-015	Data Sheet Nº 005	4
2	I-RM-3903.06-6511-211-TUK-7991	Material Requisition for Line Pipe (Local Supply)	0
3	I-RM-3903.06-6511-211-TUK-7992	Material Requisition for Line Pipe (Imported Supply)	0
4	I-RM-3903.06-1500-250-TUK-7521	Material Requisition for FSHR Pipe (Imported Supply)	0

2.4 Document Hierarchy

All pipes shall be manufactured in accordance with DNV OS-F101, API 5L and/or ISO 3183, and the requirements stated herein. In case of conflicting requirements, the strictest requirement shall apply.

Should any areas of deviation from the manufacturing requirements of these National Standards, referenced above and those herein arise then this specification shall take precedence.

3 SCOPE

3.1 Purpose and coverage

[Replacement] The purpose of this specification is to provide supplementary requirements for high strength API 5L steel line pipe, manufactured by submerged arc welding (SAW) process.

[Addition] All plate supplied for a single project shall be of a single supply source and manufactured from an identical manufacturing/processing route. Any change to this will be subject to TOUK and Petrobras review / approval.

3.2 Product specification level (PSL)

[Addition] All pipes shall be to the requirements of PSL 2 and additional requirements identified herein.

4 PROCESS OF MANUFACTURE AND MATERIAL

4.1 Cold expansion

[Addition] SAW pipes shall be cold expanded in their entire length and the cold expansion shall not exceed 1.5%.

4.2 Material

4.2.1 [Addition] Steel shall be fully killed and fine grained.

4.2.2 [Addition] Steel may be produced by continuous or conventional casting processes. Steel contained in casting of different grades, in the continuous casting processes, shall be scrapped in order to avoid contamination.

Plate produced by the Thermo Mechanical Controlled Rolled Process (TMCP) may be acceptable for manufacture of SAW linepipe.

4.2.3 [Addition] The material shall have a level of pureness in accordance with API requirements. Slag inclusions or inadequate discontinuities in pipe manufacturing process shall not be permitted. Materials inspected by ultrasonic examination, showing inclusions or other imperfections that produce indications equal to or above reference standards as per API specifications shall be rejected. All plates used to obtain the pipes shall have its surface fully ultrasonic inspected.

5 MATERIAL REQUIREMENTS

5.1 Chemical properties

5.1.1 Chemical composition

[Replacement] The chemical composition of steel used for the manufacture of pipe furnished to this specification shall conform to the maximum percentages specified below:

	Maximum Allowed Content (wt %)					
Element	X46	X52	X56	X60	X65	X70
Carbon	0.12					
Manganese	1.35	1.40	1.55	1.60	1.65	1.70
Silicon	0.30	0.35		0.40		
Phosphorus	0.020					
Sulfur	0.010					
Nitrogen	0.010				0.012	
Vanadium		0.060			0.070	
Niobium		0.050			0.060	
Copper	0.300					
Chromium	0.300					
Molybdenum	0.080					
Nickel	0.250					
Titanium	0.050					
Aluminum	0.010 to 0.060					
Oxygen						
Calcium	0.005					

Notes:
1) The sum of Vanadium and Niobium shall not exceed 0.10%;
2) The sum of Copper, Chromium, Molybdenum and Nickel shall not exceed 0.70%;
3) The sum of Niobium, Vanadium and Titanium shall not exceed 0.15%;
4) The ratio between Aluminum and Nitrogen shall be equal or greater than two.

5.1.2 Elements Analyzed

a. [Replacement] Analysis shall include, at least, the elements mentioned in item 6.1.1.
d. [Addition] Quality certificate shall contain the heat analysis report with a minimum of one analysis per heat of steel furnished.

5.1.3 Carbon Equivalent (PSL 2 only)

5.1.3.1 Maximum Carbon equivalent

[Amendment] The maximum tolerable Cev for a product analysis shall be 0.38; any proposal based on a higher Cev **(over 0.38) shall be subject to TOUK and PETROBRAS review / approval and** require justification from manufacturer.

5.1.4 Chemical composition test frequency

[Addition] A product analysis shall be carried out on each heat or batch of 50 pipes (on at least 2 samples from either), whichever is more frequent. A ladle analysis shall be carried out for each heat.

5.2 Mechanical properties

5.2.1 Tensile properties

[Addition] The maximum yield strength and UTS shall not exceed the specified minimum values by more than 130 N/mm² for all pipe grades; the yield strength to tensile strength ratio shall not exceed 0.93. The percentage elongation shall be 25% minimum.

Clause 6.2.1 Tensile Properties

(These clauses only applicable where the Purchase Order specifies that pipe is to be installed by the reeling process)

Addition:
The maximum yield strength and UTS shall not exceed the specified minimum values by more than 130N/mm2 for pipe grades up to and including X60 and by 100N/mm2 for pipe grades of X65 and above, the yield strength to tensile strength ratio shall not exceed 0.89.

Additionally for pipe grades up to and including X60, the minimum yield strength and UTS shall be no lower than the maximum achieved in production minus 100N/mm2. A stress/strain curve for each test shall be retained and submitted as part of the as-built documentation.

Addition:
A rectangular cross weld tensile specimen, in accordance with BS709, shall be taken from each test ring and the transverse tensile specimen shall be taken at 180° from the weld location. At all times the all weld metal tensile strength shall overmatch the actual production pipe material strength. A stress/strain curve shall be retained for each test and shall be submitted as part of the as-built documentation.

Addition
Additionally for pipe of an outside diameter equal to or greater than 8.625”, longitudinal tensile testing shall also be carried out in addition to and at the same frequency as the transverse testing required by API 5L and this specification. A stress/strain curve shall be retained for each test and shall be submitted as part of the as-built documentation.

5.2.2 Fracture toughness test

5.2.2.1 Charpy impact test for PSL 2

[Amendment] For SAW pipe material Charpy specimens from the weld area shall be taken from the WCL, WFL, WFL+2mm and WFL+5mm locations, parent material shall be located at 90° from the weld.

The acceptance criteria for Charpy testing shall be as detailed in the table:

	Parent Material	Weld / HAZ
Minimum Average	80 Joules	80 Joules
Minimum Individual	60 Joules	40 Joules

(a.) [Replacement] The test temperature shall be -20°C.

5.2.2.2 Supplementary fracture toughness tests

[Replacement] In addition to the requirements in (5.2.2.1), the manufacturer shall conduct fracture toughness test in accordance with SR5 and shall furnish a report of results showing compliance with the supplementary requirements specified. Unless specified in the Material Requisition (RM) the test temperature shall be the same specified in item (5.2.2.1) (a) of this specification.

5.2.3 Hardness Tests

[Addition] A Vickers hardness survey shall be carried out on a macro-section taken from one end of the selected pipes for production testing. The survey shall be carried out using a 10 kg load in accordance with BSEN ISO 6507: part 1. The survey shall be carried out as per Appendix III of this data sheet.

The maximum allowable hardness shall not exceed those given below.

Pipe Location	Max Hardness (Hv 10)	
	Flowline	Riser
Pipe Body – Internal	250	248
Pipe Body – Mid T & External	250	248
Weld Metal / HAZ	270	248

5.3 Manufacturing procedure qualification (MPQ's)

5.3.1 [Addition]

For each pipe diameter and wall thickness combination a manufacturing procedure qualification trial (MPQ) shall be carried out. From the first days production 1 pipe joints shall be selected by TOUK which shall be evaluated by all mechanical tests and inspections required by this specification. Where production is to be split into more than one phase TOUK reserves the right to request all MPQ testing be repeated. The MPQ shall also include qualification of a project specific weld procedure qualification for the long seam weld and the associated repair weld procedure qualification.

5.3.2 [Addition]

As part of the Manufacturing Procedure Qualification (MPQ's), a set of three Charpy transition curves shall be established (i.e. pipe body, weld metal and fusion line). The test temperatures shall be 20°C, 0°C, -20°C, -40°C, -60°C and -80°C.

(This clause only applicable where the Purchase Order specifies that pipe is to be installed by the reeling process)

Addition:
As part of the MPQ's three sets of Charpy specimens shall be subjected to 5% longitudinal strain and then aged at a temperature of 250°C for 1 hour and then shall be machined and tested in accordance with clause 6.2.6 of this specification. These specimens shall be pipe body (transverse)**,** WCL, WFL, WFL+2mm and WFL+5mm.The acceptance criteria as defined in clause 6.2.6.shall apply.

5.3.3 [Addition]

As part of the MPQ's the following test for surface condition shall be carried out on the first ten pipes of the first day's production.

a) Preheat pipe surface to 70°C;
b) Grit blast each pipe to SA 2½ using steel grit, typically ISO 11124-2 G17 grade or equivalent;
c) Heat to 240°C and cool in air (to simulating coating cycle).

Each pipe shall then be visually inspected. The surface condition of the pipes shall be such that a coating contractor using a single pass grit blasting system, can achieve a SA 2½ finish with a blast profile of between **60** and 100 microns. The total number of defects should be able to be removed in no longer than 3 minutes per pipe, using a hand held grinder. Where the pipe manufacturer is contracted or responsible for line pipe coating this requirement may be deleted.

5.3.4 *(This clause only applicable where the Purchase Order specifies that pipe is to be utilized in a "Sour Service" environment)*

Additional Clause:
Test coupons for step wise cracking test shall be cut. After exposure to the test, in accordance with NACE TM-02-84, using a test solution in accordance with TM-01-77, coupons shall be examined by ultrasonic testing to an approved procedure prior to sectioning. The reference reflector shall be a 2mm flat bottomed hole at mid thickness, and the area of any cracking exceeding this level shall not be more than 5% of the total surface area of the coupon. If no cracking is detected by this technique sectioning shall not be required.

If the reflection area is between zero and 5%, sections shall be taken through the strongest reflectors; the CSR value shall not exceed 2 %.(this clause only applicable where the Purchase Order specifies that pipe is to be utilized in a "Sour Service" environment)

Addition:

Three samples shall be subjected to a SSC test in accordance with NACE standard TM-01-77 and the following additions, the samples shall be taken from the pipe selected for the MPQ's.

Each sample shall be 115mm long x 15mm wide x 5mm thick and shall contain a section of the longitudinal weld at its centre; samples shall be machined from the bore of the pipe and then flattened.

The test solution shall be synthetic seawater saturated with H2S to a level of 2300-3500ppm to a give a pH of 2.7-4.0 in accordance with NACE TM-01-77. The test temperature shall be 24°C +/- 3°C and the test duration shall be 720Hrs, stress application shall be by 4 point bending to a level of 0.72 x SMYS.

On completion of testing the samples shall be scrubbed clean in water, dried and sprayed with a PVC lacquer. The edges shall be polished metallographically to a minimum of 800 grit and inspected both by eye and at a magnification of X100.

Only cracks in the through thickness direction shall be evaluated. No cracking shall occur within the test duration of 720Hrs which exceeds 0.1mm in the through thickness direction.

6 DIMENSIONS, WEIGHTS, LENGTHS AND END FINISHES

6.1 Diameter

[Amendment] The inside diameter of the pipe end (for a distance of 100 mm from the bevel) shall be checked at both ends by a rod gauge or similar type instrument to be approved by TOUK, diameter tapes shall not be permitted. The results of these checks shall be recorded for a frequency of 1 in 20 where the deviation from the nominal pipe ID shall be no more than +/- 2.0 mm where measurements are taken in 2 planes at 90° to each other. At the discretion of TOUK the nominal ID may be determined from measurement of an agreed number of pipe ends from the initial production run.

6.2 Wall thickness

[Amendment] The wall thickness measured at any point shall not vary from the specified nominal thickness by -0.75mm and +1.25mm. The wall thickness shall be determined by ultrasonic testing.

6.3 Length

[Amendment] The pipe joint shall be supplied in lengths of 12.2m +/- 0.4m. The minimum average shall be no less than 12.1m.

“Shorts” (e.g. pipes used for destructive testing) down to 11.6m will be permitted. However, the total quantity of “shorts” shall not exceed 2% of the total order quantity

6.4 Straightness

[Amendment] The total deviation from a straight line shall be ≤ 0.15% of the whole pipe length. The method of determining straightness shall be subject to TOUK approval.

[Addition] Any local deviation in straightness shall be < 3mm/m.

6.5 Jointers

[Amendment] Jointers shall not be permitted.

6.6 Workmanship and defects

Repair of Weld Defects
[Amendment] No weld repairs shall be carried out on the pipe after the cold sizing operation or on the pipe body. No weld repairs shall be carried out in the last 200mm of the pipe ends but shall have the affected length of pipe cut off. Pipe with cracks to the body or the weld area shall be rejected. A maximum of three repairs per pipe shall be permitted up-to a maximum of 5% of the pipe length, no re-repairs shall be permitted.

6.6.1 Height of outside and inside weld beads – SAW

[Amendment] The angle of weld bead re-inforcement shall be such it is suitable for application of all coating systems without “tenting“ occurring between the weld toe and the inner surface of the coating system. The maximum permissible bead height shall be 3mm. Each long seam shall be ground to flush internally for a minimum distance of 50mm and externally for a minimum distance of 150mm from each bevel.

6.7 Pipe ends

6.7.1 Plain ends

Unless otherwise specified in the ITT plain ends shall be supplied with ends beveled to an angle of 25° (+5° / 0°). Internal machining of the pipe end shall not be permitted without prior approval from TOUK.

[Addition] The entire end bevel shall be machined and root faces shall not be brought into tolerance by filling or grinding. Burr, however, may be removed by scraping or filing. The manufacturer shall provide a proper bevel protection to avoid corrosion and damages during pipe handling and transportation.

7 INSPECTION AND TESTING

7.1 Testing of chemical composition

7.1.1 Heat analysis

[Replacement] The steel manufacturer shall determine the analysis of each heat of steel used in the manufacture of pipe conform to the requirements of (6.1.1) of this specification.

7.1.2 Product analysis

7.1.2.1 Sampling frequency

[Addition] The manufacturer shall determine the analysis of two samples representing each heat of steel used for the production of pipe under this specification. Samples of at least one pipe per heat shall be taken for product analysis.

7.1.3 Test reports

[Replacement] The mill shall furnish chemical analysis report for each heat of steel used in the pipe manufacture, and chemical analysis report of products as required by this specification. Reports shall include, as minimum, those elements specified in (6.1.2) of this specification. Final tests report shall be in accordance with API Spec 5L, Supplementary Requirement SR15 and PSL 2.

7.2 Testing of mechanical properties

[Addition] Production testing shall be carried out at a frequency of one set of tests for every 50 pipes in each heat with a minimum of one set per heat; the testing shall be carried out at regular intervals throughout the heat.

7.2.1 Fracture toughness test

[Additional] Charpy testing shall be carried out on each production test pipe selected in accordance with API 5L SR5, the acceptance criteria shall be detailed in clause (6.2.5) of this specification.

7.3 Hydrostatic tests

7.3.1 Hydrostatic test requirements

[Amendment] The hold duration for the hydrostatic test shall be not less than 10 seconds.

7.3.2 Verification of Hydrostatic Test

[Replacement] In order to ensure that every length of pipe is tested to the required test pressure, each tester (except those on which continuous welded pipe is tested) shall be equipped with a recording gage that will record the test pressure and duration of time the pressure is applied to each length of pipe, or shall be equipped with some positive and automatic or interlocking device to prevent pipe from being classified as tested until the test requirements (pressure and time) have been complied with. Such records or charts shall be available for examination at the manufacturer's facility by the purchaser's inspectors.

The test pressure measuring devices shall be calibrated by means of a dead weight tester, or equivalent, prior to the start of production. Verification against a master gage or recalibration is also required after sudden depressurization caused by hydrostatic failure of seals of test device or with change of wall thickness or grade. Retention of calibrations records shall be as specified in (12.2).

7.3.3 Test pressures

[Amendment] The test pressure shall result in a hoop stress (based on a specified minimum wall thickness) equal to 95% of the SMYS.

7.4 Visual inspection

[Amendment] The internal and external surface shall be free of loose millscale and loose rust after brushing / "blowing out".

7.5 Non destructive inspection

NDT Level I shall be applied according to DNV OS-F101.

[Addition] All NDE shall be performed on completion of heat treatment and hydrostatic testing. Where it is impractical to carry out hydrotesting after final NDE then the manufacturer shall re-route 10 first day production pipes through the NDE station in order to show that no defect extension has occurred due to pressure testing.

7.5.1 Qualification of Personnel

[Addition] All operators shall be qualified to ASNT Recommended Practice SNT-TC-1A or equivalent, operators shall be qualified to level 1 or 2 with supervisors qualified to level 3.

[Addition] All plate material shall be inspected to BS EN 10160S1E3

Each completed pipe length shall have the long seam weld examined in accordance with API 5L sect (9.8.3), and the completed bevels shall be inspected for laminations and cracks by 100% MPI and manual ultrasonics over a width of 100 mm from the bevel at each end.

Any lamination which equals or exceeds the reference level (as described in EEMUA 166:1991), or inclusion, which causes a reduction of 50% or more in the back wall echo or any indication from other flaws which equal or exceed the reference level shall all be cause for rejection.

7.5.2 Ultrasonic and Electromagnetic Inspection

7.5.2.1 Equipment

[Replacement] Any equipment utilizing the ultrasonic principles and capable of continuous and uninterrupted inspection of the weld seam shall be used. Ultrasonic equipment shall have audio or visual alarms to denote both loss of coupling and signals in excess of the acceptance limit.

The equipment shall be checked with an applicable reference standard as described in (9.8.5.2 at least twice per operating shift to demonstrate its effectiveness and the inspection procedures. Any residual product used as couplant for both manual and automatic ultrasonic equipment shall be completed removed before the welding phase.

The equipment shall be adjusted to produce well-defined indications when the reference standard used by the manufacturer is scanned by the inspection unit in a manner simulating the inspection of the product and shall be capable of inspecting 1/16 in. (1.6 mm) on each side of the weld line of the entire wall thickness. Sensitivity of equipment shall be checked twice per shift, in the dynamic mode, on the reference standard. Restrictions on residual magnetism in pipe are given in 9.8.7.

7.5.3 Residual magnetism measurements requirements

[Additional clause] The residual magnetism in finished pipes shall be checked by measurement of the magnetic flux density at a location immediately adjacent to the pipe ends using a suitable probe or gauss meter approved by TOUK. Checks shall be carried out on 3 pipes per shift in the as supplied condition with the maximum permissible level of magnetism being 20 Gauss.

Manufacturer shall be responsible for ensuring that the maximum level of residual magnetism is not exceed in the “as delivered” condition (i.e. TOUK nominated storage yard, installation vessel or spoolbase).

e. [Replacement] as a minimum, four readings shall be taken approximately 90° apart round the circumference of each end of the pipe. The average of all reading shall not exceed 10 gauss (1.0 mT), and no one reading shall exceed 12 gauss (1.2 mT) when measured with a Hall-effect gaussmeter, or equivalent values when measured with other types of instruments.

7.6 Disposition of pipes containing defects

[Amendment] Repair of pipe body defects by welding shall not be permitted.

8 MARKING

[Addition] A coloured paint band, minimum 50 mm wide shall be applied to the internal surface of each pipe, 100 mm from the end. The colour system shall be such that pipes of similar diameters but differing wall thickness are readily identifiable.

8.1 General

[Replacement] Pipes shall be marked by the manufacturer according to Spec API 5L encompassing the following formats:

- Manufacturer's name or mark.
- API monogram.
- Purchase order number.
- Pipe specification (API Spec. 5L) and grade, including designations for C, V, T additions elements (if any).
- Outside nominal diameter, in inches.
- Nominal thickness, in inches and millimeters (this figure enclosed between parenthesis) rounded respectively to a thousandth and to a hundredth of the unit. Ex.: 0.500 in (12, 70 mm).
- Pipe length in meters, rounded to a hundredth of the unit. Ex.: 10.67 m.
- Weight per length in Kgf/m, rounded to a hundredth of the unit. Ex.: 219.91 Kgf/m.
- Pipe identification number.
- Heat steel number.
- Impact test type, minimum required energy (absorbed) and test temperature. Ex.: SR5B-60J-0°C.
- Inspection agency's name or mark.

8.2 Locations of markings

[Replacement] The markings shall be clearly painted in white, in capital letters located on one of the ends of pipe as follows:

a) Markings shall be painted stencil on the inside surface. These markings shall be made immediately after the purchaser acceptance and an enamel layer for identification preservation shall be applied over the paint stencil.

b) As an alternative for pipes with internal and external coating or diameter up to 8" the manufacturer can mark the pipe identification number inside the pipe and apply a label with all other characteristics on the outside surface. The manufacturer shall assure this label has a minimum lifetime of 24 months.

8.3 Sequence of markings

8.3.1 Supplementary Requirements

Replacement] Pipe identification number, heat number and purchase order number shall be included in area to be marked. Color identification shall be in accordance with SR3.

8.4 Length

[Replacement] The length, as measured on the finished pipe, shall be paint stenciled using meter to two decimal places.

8.5 Die stamping

[Replacement] Die stamping on the pipe body is prohibited.

8.6 Data book

[Addition] The manufacturer shall furnish a list of the produced pipes containing the following information: pipe identification number, heat of steel number, dimensions, lot and pipe weights, purchase order number, types of certificates issued, and other items included in the purchase order.

All Data Book information shall be in general accordance with the requirements of DNV OS F101 section 6, part G as further defined by the applicable Contract Quality Assurance Requirements.

8.7 Color identification

[Addition] Color identification shall be in accordance with API Spec 5L, Appendix F, Supplementary Requirement SR3.

9 COATING AND PROTECTION

[Addition] Temporary external coatings (e.g. varnish) shall only be applied to areas which have pipe identification markings, all other areas shall be left uncoated.

Unless agreed otherwise by TOUK, all pipes shall be supplied fitted with recessed plastic end caps which can be lifted using crane hooks.

10 PIPE LOADING, STORAGE AND TRANSPORTATION

[Addition] All pipe handling, storage and transportation shall be conducted in accordance with approved procedures which are in full compliance with the applicable Contract Health, Safety and Environmental requirements.

11 APPENDIXES

11.1 Appendix I

First Day Production Tests

11.1.1 General

A minimum of three pipes of first day of production shall be selected at random for tests to verify if manufacturing procedures result in acceptable pipes. If more than one heat is used, at least two heats shall be represented by the test pipes. Tests shall be repeated whenever there is a change in manufacturing procedures.

11.1.2 Non Destructive Testing

a) Visual Inspection

All test pipes shall be examined visually for dimensional tolerances and surfaces defects in accordance with section 9 of API Spec 5L.

b) Ultrasonic Inspection

The weld seams of all test pipes shall be examined by an automatic ultrasonic scanning device in accordance with section 9 of API Spec 5L.

c) Radiological Inspection

The weld seams of all SAW test pipes shall be radiographically examined throughout their full length in accordance with section 9 of API Spec 5L.

11.1.3 Testing of Mechanical Properties

a) Weld Seam and Base Metal

The weld seam and base metal of all test pipes shall be tested in accordance with paragraph 9.3 of API Spec 5L.

b) Charpy Impact Test

Test shall be carried out in accordance with section 9.3.5 of API Spec 5L, in specimens obtained from all test pipes. Three transverse specimens shall be taken from the longitudinal seam with the notch located at the weld axis and three transverse specimens shall be taken from base material.

c) Macrographic, Micrographic and Hardness Examination

SAW Pipe

Specimens shall be extracted from one of SAW test pipes at three locations along the weld. These specimens shall be polished and etched for macrographic inspection. This inspection shall provide evidence that proper fusion has been obtained throughout the full thickness of the joint, the extent of interpenetration and alignment of internal and external weld passes

A series of Vickers hardness tests for one of SAW test pipes shall be made on one of etched specimens. The series shall extend from base metal on one side across the weld to base metal on the other side, both outside the HAZ. Three series of readings shall be made, one 2 mm from the outer edge, the second across the center and the third 2 mm from the inner edge. The spacing between the hardness readings shall be 1 mm.

Acceptance Criterion

No hardness measurement shall exceed 270Hv10 of the Weld Metal / HAZ (Flowline) and 248Hv10 of the Weld Metal / HAZ (Riser).

11.2 Appendix II

11.2.1 Weldability Test

[Addition] The manufacturer shall supply weldability data for a product which is reflective of the project line pipe in terms of grade, dimensions, process route, chemical composition and heat treatment. Should this data be unacceptable to TOUK the manufacturer shall carry out weldability trials under the instruction of TOUK at the manufactures cost.

11.2.2 The manufacturer shall perform a weldability test for the following conditions:

- Plate with the highest Carbon content;
- Plate with the highest Carbon equivalent content;
- Plate with the highest PCM;
- Plate with the highest Phosphorus content.

11.2.3 The ladle analysis can be used to select the plates to be tested.

11.2.4 The welding shall be performed with the heat input of 1 kJ/mm.

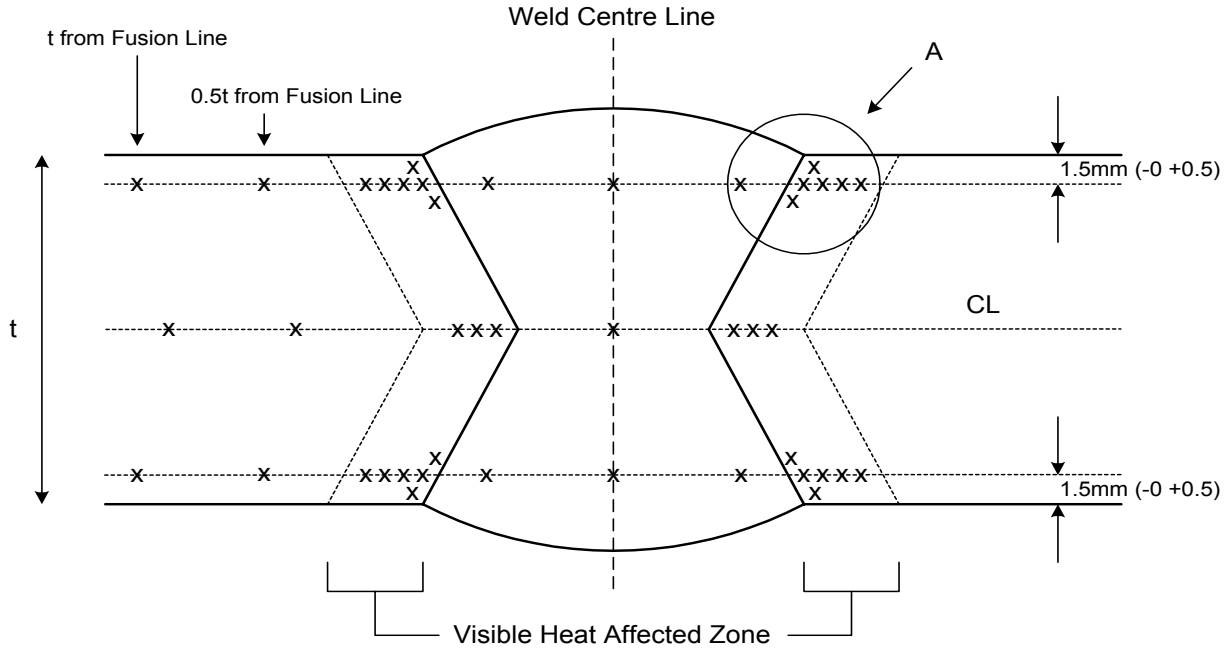
11.2.5 The hardness measurement shall be made across the HAZ and the maximum hardness value shall be 248Hv10 (Riser) and 270 Hv10(Flowline).

11.2.6 Plates subjected to this test qualify other plates with lower composition content.

Note: P_{CM} = C + (Si/30) + [(Mn + Cu + Cr)/20] + (Ni/60) + (Mo/15) + (V/10) + 5B

11.3 Appendix III

HARDNESS SURVEY



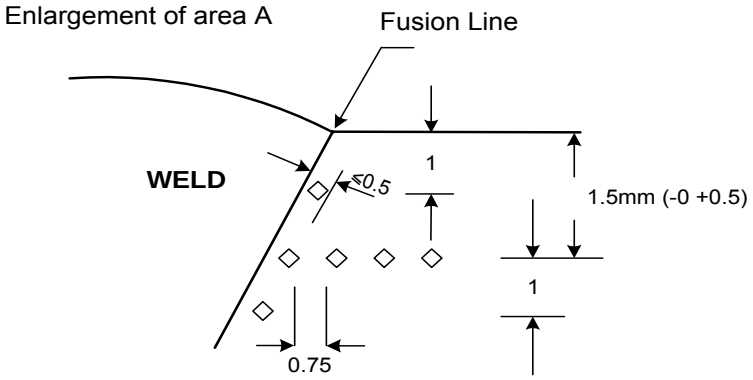


Figure 1