

	TECHNICAL SPECIFICATION				No. I-ET-3000.00-1500-29B-PAZ-005					
	CLIENT:							SHEET 1 of 6		
	JOB:							-		
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SUB/ES/DCT		TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS					NP-1			
							SUB/ES/DCT			
INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
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A	All pages, including document title									
B	Inclusion of the maximum allowable hardness for the end fittings Inclusion of the minimum PREN									
C	Exclusion of the minimum PREN and inclusion of the pitting corrosion quality test Inclusion of a reference for material derating Inclusion of requirements for the material microstructure Exclusion of the minimum hardness requirement Changes on the hydrogen embrittlement requirements									
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	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1500-29B-PAZ-005	REV. C
			SHEET 2 of 6
	TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS		NP-1

INDEX

1	Scope	3
2	References	3
2.1	International standards.....	3
2.2	PETROBRAS specifications	3
3	Terms, abbreviated terms and definitions	3
3.1	Terms and definitions.....	3
3.2	Abbreviated terms	4
4	General.....	4
5	Materials selection.....	4
6	Tube sizing	4
6.1	Wall thickness	4
6.2	Material strength	4
7	Corrosion.....	4
8	Hydrogen embrittlement.....	5
9	Tube manufacture	5
9.1	Microstructure	5
10	Tube welding	5
11	Qualification tests	5
12	End fittings.....	6

	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1500-29B-PAZ-005	REV. C
			SHEET 3 of 6
	TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS		NP-1

1 Scope

This technical specification defines the minimum requirements for the design, manufacture, qualification and acceptance tests of metallic tubes and end fittings for subsea umbilical systems.

2 References

NOTE: Unless otherwise stated, the latest revision of the following documents must be considered.

2.1 International standards

- [1] ISO 13628-5, *Petroleum and natural gas industries – Design and operation of subsea production systems – Part 5: Subsea umbilicals*
- [2] DNVGL-ST-F201, *Riser systems*
- [3] ASTM G48-11, *Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution*
- [4] DNVGL-RP-F112, *Duplex stainless steel – design against hydrogen induced stress cracking*
- [5] ISO 17781, *Petroleum, petrochemical and natural gas industries – Test methods for quality control of microstructure of ferritic/austenitic (duplex) stainless steels*
- [6] DNVGL-ST-F101, *Submarine pipeline systems*

2.2 PETROBRAS specifications

- [7] I-ET-3000.00-1519-29B-PZ9-003, *Subsea Umbilical Systems*
- [8] I-ET-3000.00-1500-29B-PAZ-006, *Qualification of Subsea Umbilicals*

3 Terms, abbreviated terms and definitions

PETROBRAS adopts the same terms, abbreviated terms and definitions as in [1], with the amendments and supplements defined in this section.

3.1 Terms and definitions

MANUFACTURER

subsea umbilical manufacturer

may


verbal form used to indicate a course of action permissible within the limits of this specification

shall

verbal form used to indicate requirements strictly to be followed in order to conform to this specification

should

verbal form used to indicate that a provision is not mandatory, but is recommended as good practice

	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1500-29B-PAZ-005	REV. C
			SHEET 4 of 6
	TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS		NP-1

TUBE SUPPLIER

metallic tubes supplier

3.2 Abbreviated terms

IVA independent verification agent

L_{res} length of zone assumed to be influenced by weld residual stresses

4 General

The metallic tubes and their end fittings shall be designed, manufactured, and tested according to [1] and this technical specification. The requirements presented on this technical specification are complementing and, in case of conflict, prevail over the requirements of [1].

5 Materials selection

Metallic tubes for subsea umbilicals shall be seamless super duplex stainless steel, being UNS S32750 and UNS S39274 the accepted grades. Other materials are not acceptable even if a bonding film, coating, or layer is applied.

6 Tube sizing

6.1 Wall thickness

Design calculation (including criteria for collapse and propagating buckling) shall be part of the Design Report additionally to the items required in [7], considering the following:

- tube external pressure considering the maximum water depth;
- water density of 1025 kg/m³
- tube internal pressure of 0,1 MPa and
- 1.5% ovality

6.2 Material strength

As stated in [1], the effect of temperature on the SMYS of the tube material shall be considered on the tube sizing calculations. Temperature derating should be addressed according to the requirements of [2].

7 Corrosion

Pitting corrosion test shall be performed according to Method A stated in [3] for parent and welded materials quality control. Test duration shall be 24 (twenty-four) hours and no pitting is allowed at 20x magnification. Acceptable test temperature and maximum weight loss shall be in accordance with Table 1. This test shall be performed for both parent and welded material, for each tube dimension and shall be repeated whenever welding procedures are changed or new welding equipment is employed. Penetrant testing is recommended to judge if pitting is present or not.


	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1500-29B-PAZ-005	REV. C
			SHEET 5 of 6
	TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS		NP-1

Table 1 - Criteria to weight loss

Position	Temperature (°C / °F)	Weight loss (g/m ²)
Parent material	50 / 122	1
Orbital weld	40 / 104	4

8 Hydrogen embrittlement

The tubes are considered safe against hydrogen-induced stress cracking provided that the recommendations and design criteria established in [4] are fulfilled. Approval by either category 1 or 2 assessment criteria are accepted. Tube with OD < 2 in are acceptable according to this document without stress and strain analysis provided that cold bend areas are not located within L_{res}. The design premises and calculations shall be presented to PETROBRAS.

Approval based on hydrogen embrittlement testing can be accepted, assuming that the test procedures are agreed in advance with PETROBRAS. The tubes can be considered safe against hydrogen embrittlement if electrical insulation and/or a waterproof coating is applied provided that the results of a previously agreed qualification program of this insulation scheme are accepted by PETROBRAS.

9 Tube manufacture

9.1 Microstructure

The microstructure requirements of [5] shall be achieved. The tubes shall be subjected to complete solution treatment, followed by a proper quenching procedure, in order to obtain a microstructure free of harmful phases such as nitrides and sigma phase. The material shall be free from grain boundary carbides, nitrides, martensitic and intermetallic phases. According to [6], occasional strings of detrimental phases are acceptable given that the phase content within one field of vision (at 400x magnification) is < 1.0% (max. 0.5% intermetallic phases). The microstructure examination of parent and welded material shall be performed and documented at a minimum magnification of 400x.

10 Tube welding


Both MANUFACTURER and TUBE SUPPLIER must follow the requirements stated on [1], regarding tube welding and NDE on girth welds. MANUFACTURER's welding, inspection, and non-destructive weld testing procedures (including acceptance criteria) must be available for PETROBRAS evaluation.

All tube girth welds shall be automated produced, exception made to repair girth welds between tube strings and in the terminations, which may be done by means of manual process.

11 Qualification tests

The proposed metallic tube design(s) must be qualified for the specified functional requirements (i.e., DWP, inner diameter, maximum operating water depth, inner fluids, service life etc.). The qualification program stated in [8] shall be followed, including the certification by an IVA.

At least the tests stated on [1] shall be performed. PETROBRAS and MANUFACTURER may agree to perform additional tests to better investigate failure modes applicable to the proposed design concept, including welds.

	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1500-29B-PAZ-005	REV. C
			SHEET 6 of 6
	TITLE: METALLIC TUBES AND END FITTINGS FOR SUBSEA UMBILICAL SYSTEMS		NP-1
			SUB/ES/DCT

12 End fittings

Metallic tubes shall be supplied with Autoclave® medium pressure (20,000 psi) end fittings, independently from the required DWP.

All requirements for the metallic tubes stated on this specification apply also to their end fittings.