

	SPECIFICATION			Nº I-ET-3000.00-1000-972-1AL-005						
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	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 2 de 15
			PUBLIC
			QB

INDEX

1. PURPOSE	3
2. REFERENCES.....	3
3. DEFINITIONS, TERMINOLOGIES AND ACRONYMS	4
4. MINIMUM MANUFACTURING INSPECTION ACTIVITIES	4
5. MANUFACTURING AND QUALITY INSPECTOR.....	6
6. INSPECTION PLANNING	7
7. INSPECTION AND TEST PLAN	8
8. PERSONNEL AND PROCEDURES QUALIFICATION.....	10
9. EXECUTION OF MANUFACTURING INSPECTION	11
10. QUALITY RECORDS.....	13
11. HANDLING, MOORING, PRESERVATION, STORAGE AND SHIPPING.....	14
12. MANUFACTURING QUALITY AUDIT	14

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 3 de 15
			PUBLIC
			QB

1. PURPOSE

1.1. This document establishes the minimum quality requirements that shall be considered and observed by the Supplier during the whole Subsea Flexible Pipe and Ancillary equipment manufacturing process and shall be considered as a complementary document to ET-0000.00-0000-972-1AL-001 – Quality of Materials General Requirement.


1.2. This Quality Requirement applies to the Family of Material Subsea Flexible Pipe and Ancillary equipment.

NOTE 1: All components mounted on the Flexible Pipe during manufacture and installation are considered Ancillary Equipment.

NOTE 2: In case of conflict with ET-0000.00-0000-972-1AL-001, this Complementary Requirement shall prevail.

2. REFERENCES

- 2.1. ABNT NBR 16278 - Manufacturing Inspection - Personnel Qualification and Certification for the Oil and Gas Sector
- 2.2. ABNT NBR 14842 - Criteria for the Qualification and Certification of Welding Inspectors
- 2.3. ISO 9001 - Quality Management System - Requirements
- 2.4. ISO 9712 - Non-Destructive Testing - Qualification and Certification of NDT Personnel
- 2.5. API SPEC 17J - Specification for Unbonded Flexible Pipe
- 2.6. API SPEC 17L1 - Specification for Flexible Pipe Ancillary Equipment
- 2.7. API RP 17L2 - Recommended Practice for Flexible Pipe Ancillary Equipment
- 2.8. API RP 17B - Recommended practice for Flexible Pipe
- 2.9. I-ET-0000.00-0000-972-1AL-001 - Quality of Materials General Requirement
- 2.10. ET-3000.00-1500-251-PAZ-001 - Fixadores em Aço de Alta Resistência para Utilização Submarina
- 2.11. ET-3000.00-1500-251-PAZ-002 - Rastreabilidade de Fixadores em Aço de Alta Resistência para Utilização Submarina
- 2.12. ET-3000.00-1500-950-PMU-001 - Revestimento de níquel químico com tratamento térmico de Interdifusão
- 2.13. ET-3000.00-1500-941-PMU-003 - Padronização de Acessórios para Kit Pull-In

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 4 de 15
			PUBLIC
			QB

- 2.14. I-ET-3010.00-1500-960-PPC-011 - General Bend Stiffener Requirements
- 2.15. PETROBRAS NI-13 - Technical Requirements for Paintwork
- 2.16. PETROBRAS NI-133 - Welding
- 2.17. PETROBRAS NI-2301 - Preparation of the Welding Technical Documentation

NOTE 1: The documents applicable to the project are not limited to those listed in this Complementary Quality Requirement. Other documents related to the contract shall be observed and fulfilled.

NOTE 2: The edition/revision of the documents applicable to the project will be that defined in the contractual documentation, if not specified, the current edition/revision on the date of signature of the contract applies.

NOTE 3: PETROBRAS NI-133 e NI-2301 are considered guidelines, and may be followed by Supplier, according to its convenience, when project specifications do not provide details about welding process.

3. DEFINITIONS, TERMINOLOGIES AND ACRONYMS

- 3.1. The definitions and acronyms adopted in this document are in accordance with I-ET-0000.00-0000-972-1AL-001 and ABNT NBR 16278.
- 3.2. When preparing the **Inspection and Test Plan (ITP)**, the acronyms defined in I-ET-0000.00-0000-972-1AL-001 shall be applied.

4. MINIMUM MANUFACTURING INSPECTION ACTIVITIES

- 4.1. In addition to I-ET-0000.00-0000-972-1AL-001, the following activities shall be performed and recorded by the **Responsible for the Manufacturing Inspection (RIF)** for each Flexible Pipe and its Ancillary Equipment.

NOTE: In order to ensure compliance of the material with the contractual requirements, other activities, besides those listed below, may be followed and duly registered at the discretion of the RIF.

- 4.1.1. The Responsible for the Manufacturing Inspection shall consider, at least, the following steps as **Hold Points at Supplier**, which shall be set out in the ITP:

TITLE: **COMPLEMENTARY QUALITY REQUIREMENTS
OF FLEXIBLE PIPE AND ANCILLARY
EQUIPMENT**

PUBLIC

QB


- a) Final inspection of ancillary equipment before assembling on Flexible Pipe;
- b) Assembly process of the connectors in the Flexible Pipe;
- c) Flange sealing tests;
- d) Factory acceptance tests - FAT;
NOTE : In the FAT follow-up, all activities defined in the design standard shall be considered.
- e) Adhesion tests of identification paint and marking on the outer sheath;
- f) Verification of marking and identification of the Flexible Pipe;
- g) Packing and final mooring of the Flexible Pipe and ancillary equipment;
- h) Verification of manufacturing technical documentation book (data book of the flexible pipe and its ancillary equipment);
- i) Rework/repairs that are not according to design condition or contractual specification.

4.1.2. The Responsible for the Manufacturing Inspection shall consider, at least, the following steps as **Document Review**, which shall be set out in the ITP:

- a) Verification and approval of all certificates of raw materials used in the manufacture of Flexible Pipe and its critical components;
NOTE: Special attention to the expiration date of the polymers.
- b) Verification and approval of all manufacturing technical documentation as defined in the ITP (quality registries and reports);
- c) Verification and approval of the production test records of the respective runs of materials involved in the manufacture of the carcass and the pressure and traction armor layers, in particular the HIC and SSC tests;
- d) Verification/approval of the treatment contained in the nonconformities issued by the Supplier.

4.1.3. The Responsible for the Manufacturing Inspection shall consider, at least, the following steps as **Monitoring Points at Supplier**, which shall be set out in the ITP:

- a) Manufacturing process of all layers;
- b) Collection of specimen for CIV (corrected inherent viscosity) of internal sheath in PA-11;
- c) Spark test in the internal pressure sheath, prior to the installation of the pressure armour;
- d) Welding processes of pressure armour, tensile armour and carcass (when applicable);

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 6 de 15
			PUBLIC
			QB

- a) Epoxy compression test;
- b) Nondestructive testing.

4.1.4. The Responsible for the Manufacturing Inspection shall consider, at least, the following steps as **Hold Points at Sub-supplier**, which shall be set out in the ITP:

- a) Top Bend stiffener: visual and dimensional examination and review of the technical documentation and other requirements as per I-ET-3010.00-1500-960-PPC-011;
NOTE: Special attention to the characteristics of the Inconel® coating (roughness and cracking), inspection of the nickel interdiffusion layer (thickness, cracks, porosity, roughness and adhesion), inspection of the polyurethane coating (hardness, tensile, bending and adhesion).
- b) Visual inspection, final dimensional inspection and document review of the other components, such as connectors and metal rings joints and floats (buoyancy and module), considering specific requirements ET-3000.00-1500-950-PMU-001 and ET-3000.00-1500-941- PMU-001;
- c) Verification of the book of technical documentation of manufacture (data book) of all the ancillary equipment.


NOTE : It is at Supplier's discretion to perform activities above at the Sub-contractor's premises or at another location.

4.1.5. The Responsible for the Manufacturing Inspection shall consider to verify at the Supplier or Sub-supplier, as a **Hold Point**, other inspection and control activities, implemented as a result of corrective actions resulting from Nonconformities, COD or anomalies observed on site.

5. MANUFACTURING AND QUALITY INSPECTOR

5.1. The Manufacturing Inspectors of the AIB shall be certified according to ABNT NBR 16278, modality IF-TF, to act directly in the inspection of manufacturing and assembly activities of the Flexible Pipe. For the inspection of ancillary equipment, certifications in modalities IF-PP, IF-CT and IF-AT may be used, according to the characteristics of the object to be inspected.

5.2. API SIFE (Source Inspector Fixed Equipment) certification is also acceptable. Other similar certifications, issued by internationally recognized, independent entities, may be accepted, but they shall be

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 7 de 15
			PUBLIC
			QB

submitted to previous approval of the PETROBRAS Quality of Material Department.

5.3. In case of Supplier is waived of contracting the AIB, the RIF shall be certified according to 5.1, in order to act at least as set forth in section 4. The API SIFE certification is also acceptable. Other similar certifications, issued by internationally recognized, independent entities, may be accepted, but they shall be submitted to previous approval of the PETROBRAS Quality of Material Department.

NOTE: The assignments of the Manufacturing Inspector are defined in ABNT NBR 16278.

5.4. For the certification of Manufacturing Inspector abroad, the equivalence defined in I-ET-0000.00-0000-972-1AL-001 shall apply.

6. INSPECTION PLANNING

6.1. PRE MANUFACTURING MEETING - PMM


In addition to the item in I-ET-0000.00-0000-972-1AL-001 which provides the purposes of the PMM, the Supplier shall submit / confirm the prequalification of the structure of the contracted Subsea Flexible Pipe, with approval by the classifying society.

NOTE 1: This meeting may include more than one purchase order (PC), since that they have the same contractual technical design, structures, requirements and specifications.

NOTE 2: In case the Purchase Order presents the same projects, structures, requirements and specifications already evaluated and discussed in other PMMs (previously performed and related to the same contract), it is at the Supplier's discretion to hold a new PMM meeting. If Supplier decided not holding this meeting, the Supplier shall register that the same definitions discussed and validated in previous PMMs are valid for the referenced purchase order.

6.2. PLANNING OF INSPECTION EVENTS AT SUPPLIER FACILITIES

6.2.1. In addition to ET-0000.00-0000-972-1AL-001, the Supplier shall prepare, before the beginning of the manufacture process, an initial planning to realize the manufacturing of the product, from placing the

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 8 de 15
			PUBLIC
			QB

purchase order up to its delivery. This planning shall be focused on the inspection and tests pointed out in the ITP of Umbilical and its Ancillary equipment.

6.2.2. This planning shall be submitted for the acknowledgement and comments of the RIF before the beginning of the manufacture, also including the inspection activities at Sub-suppliers.

6.3. PLANNING OF INSPECTION EVENTS AT SUBSUPPLIER FACILITIES

6.3.1. The Sub-suppliers of materials, components and consumables for the manufacture of the equipment shall be duly approved by the supplier evaluation methodology, according to its Quality Management System.


6.3.2. The Supplier shall select and evaluate the Sub-suppliers in accordance with the requirements of ISO 9001, of the Quality of Material General Requirement, of this complementary requirement and other contractual documents, where and when applicable, to ensure compliance with all requirements and criteria established for the supply, with periodic revaluations methodology, aiming the continuous improvement in this process.

6.3.3. The qualification criteria and the frequency of requalification of these Sub-suppliers shall be submitted to comments by the RIF.

7. INSPECTION AND TEST PLAN

7.1. An ITP shall be prepared for each Flexible Pipe, main components and its ancillary equipment to be supplied, ensuring compatibility of materials with project requirements, procedures and contractual documentation.


7.2. In order to ensure the conformity of the material in accordance with the contractual conditions, the RIF shall define, upon the ITP approval, for each Purchase Order, the extent of its participation on the inspections and tests to be performed at the Supplier's facilities, covering, at a minimum, the inspection activities set out in ET-0000.00-0000-972-1AL-001 and in section 4.

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
			Sheet 9 de 15
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		PUBLIC
			QB

7.3. The Sub-suppliers' ITP shall be in accordance with the technical requirements and acceptance criteria set out in the project and in the contractual documentation, including, along the manufacturing process, the level of participation of the Supplier inspection and the Responsible for the Manufacturing Inspection according to section 4.

7.4. In compliance with and complementing API SPEC 17J standard, the specifications and the contractual requirements, the activities listed below shall be included in the ITP of the Flexible Pipe and its critical components, including their respective records, where and when applicable, depending on the structure, specifications and contractual requirements:

- a) Review of certificates and traceability of raw material;
- b) Verification of the steps of the manufacturing process of all the sheaths;
- c) Verification of the steps of the manufacturing process of the ancillary equipment and components;
- d) Verification of the welding process of the metallic layers;
- e) Verification of nondestructive testing;
- f) Visual inspection of bottom / top connectors;
- g) Final inspection of ancillary equipment;
- h) Verification of the assembly of the connectors and assembly quality assurance test;
- i) Final inspection of ancillary equipment assembly;
- j) Verification and inspection of repairs;
- k) Factory Acceptance Test - FAT;
- l) Checking / identifying marking and final dimension of the Flexible Pipe;
- m) Final verification of Flexible Pipe;
- n) Packaging of ancillary equipment and spare parts;
- o) Check of packing and final mooring of the flexible pipe and ancillary equipment;
- p) Verification of manufacturing technical documentation book (data book of flexible Pipe and ancillary equipment).

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 10 de 15
			PUBLIC
			QB

8. PERSONNEL AND PROCEDURES QUALIFICATION

8.1. PERSONNEL QUALIFICATION

For inspections of welding, nondestructive, dimensional control and painting, the Supplier shall comply with ET-0000.00-0000-972-1AL-001, with the additional requirements below:

8.1.1. Nondestructive Testing

Nondestructive testing activities shall preferably be carried out by inspectors certified according to ISO 9712.

8.1.1.1. The execution of Nondestructive testing not required by Standard or by contractual technical specification, i.e., for additional quality control, at the Supplier's exclusive discretion, it is admitted the certification according to the Recommended Practice SNT-TC-1A in substitution of ISO 9712.

8.1.2. Dimensional Control Inspector


Unless otherwise specified, professionals without certification may be used; however, these shall have training and proven qualification in metrology to carry out the dimensional inspections during the Flexible Pipe and Ancillary equipment manufacturing process.

8.1.3. Welding Inspector

Unless otherwise specified, professionals without certification may be used; however, these shall have training and proven qualification to carry out the welding inspections during the Flexible Pipe and Ancillary equipment manufacturing process.

8.1.4. Painting and Coating Inspectors

Unless otherwise specified, professionals without certification may be used; however, these shall have training and proven qualification to perform painting and coating inspections during the Flexible Pipe and Ancillary equipment manufacturing process.

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
			Sheet 11 de 15
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		PUBLIC
			QB

8.2. PROCEDURES QUALIFICATION

8.2.1. The Supplier shall qualify the following procedures before the beginning of the respective activity:

- a) Radiography;
- b) Ultrasound;
- c) Penetrating liquid;
- d) Magnetic particles;
- e) Visual;
- f) Hardness;
- g) Welding, according to PETROBRAS NI-133 and NI-2301;
- h) Repair

NOTE: All repair procedures permitted by the contract specifications shall be qualified according to the characteristics of the defects observed and shall also be analyzed and validated by the Responsible for the Manufacturing Inspection at the time of inspection.

8.2.2. Other Required Procedures shall be qualified according to the contractual premises and/or technical requirements of the project. These procedures shall be evaluated and validated by the RIF and shall comply with the contract.


9. EXECUTION OF MANUFACTURING INSPECTION

The following items shall be considered in addition to those defined in ET-0000.00-0000-972-1AL-001:

9.1. MINIMUM ACTIVITIES TO START MANUFACTURING

To start manufacturing, the following conditions must be met:

- a) Present Unifilar and Cross Section approved by the Supplier's engineering according to the contract;
- b) ITP approval by RIF;
- c) Holding PMM.

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
			Sheet 12 de 15
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		PUBLIC
			QB

9.2. WELDING PROCESS


9.2.1. The following documents shall be available for verification by the RIF, when applicable or required in the project, before performing the inspection and test activity according to ITP:

- a) Training and qualification of welding inspectors;
- b) procedure of storage and handling of welding consumables approved by certified welding inspector or FBTS welding engineer;
- c) WPS, PQR and welding plans approved by certified welding inspector or FBTS welding engineer;
- d) Qualification Records of welders and/or welding operators, including tack welders, according to PETROBRAS NI-2301;
- e) Quality certificate of welding consumables;
- f) Performance control criteria of welders and/or welding operators according to PETROBRAS NI-133, when required in contract.

9.3. INSPECTION AND TESTING ACTIVITIES

9.3.1. During the manufacturing process, the following documents shall be available for verification by the RIF prior to performing the respective inspection and test activity, according to the ITP:

- a) Certification of manufacturing inspectors;
- b) Qualification of welders and welding operators;
- c) Certification or evidence of qualification/training of NDT inspectors;
- d) Training and qualification of dimensional examination inspectors;
- e) Training and qualification of the professionals responsible for assembling the connectors;
- f) Qualification and analysis of the adequacy of the inspection procedure by nondestructive testing by level 3 inspector in the corresponding technique;
- g) Qualification and analysis adequacy of the painting procedure to the project;
- h) Dimensional examination procedure qualified by the Supplier's product engineering or by a dimensional examination inspector;

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		Sheet 13 de 15
			PUBLIC
			QB

- i) Indication of the devices / equipment, including required accuracy, used to verify critical dimensions, operation and performance tests;
- j) Procedure for identification, transfer and control of traceability of materials;
- k) Nonconformity report (NCR) control procedure as defined in the Supplier's Quality Management System;
- l) Drawings released for manufacturing;
- m) Welding procedures;
- n) PMI procedure;
- o) Factory acceptance testing procedure (FAT);
- p) Ancillary equipment assembly procedure;
- q) Internal and/or external coating application procedure;
- r) Procedures for cleaning and preservation of the Submarine Flexible Pipe;
- s) Repair procedure;
- t) Certificate of calibration of instruments to be used for inspection and factory testing;
- u) Packing, mooring, shipping, transport and storage procedures.


9.3.2. All activities defined in the ITP, such as HP, WP, RD and MP, shall be performed and registered by the RIF.

9.3.3. The records of the HIC (hydrogen induced cracking) and SSC (sulfide stress cracking) tests shall be verified and approved by the RIF, ensuring the satisfactory result and traceability of the materials used in the manufacture of the Flexible Pipe.

10. QUALITY RECORDS

In addition to the document required by the API SPEC 17J, as a minimum, the following documents shall be issued and made available by the Supplier, reviewed and approved by the RIF:

- a) Certificate of raw material for the Flexible Pipe layers and ancillary equipment;
- b) Incoming Report of materials and ancillary equipment, with guarantee of traceability of materials/equipment;
- c) Nondestructive testing report provided according to the ITP and drawings;
- d) Nonconformity Report containing the respective treatment by the Supplier, corrections and corrective actions;

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
			Sheet 14 de 15
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		PUBLIC

- e) Technical queries between PETROBRAS and the Supplier;
- f) Report of dimensional control;
- g) Report of destructive tests;
- h) Welding inspection reports;
- i) Certificate of welding consumables (if applicable);
- j) Record of stress relief heat treatment (if applicable);
- k) Connector assembly report;
- l) Report of assembly of ancillary equipment;
- m) Factory acceptance test report of Flexible Pipe;
- n) Inspection report on the application of coating/painting of ancillary equipment, detailing the preparation of the surface, each layer applied, as well as results regarding the thickness and adhesion and mapping of the touched up regions;
- o) Report of repair of metallic and polymer layers;
- p) Final report of identification and length;
- q) Photographic registry of mooring, preservation and packaging;
- r) Certificate of conformity;
- s) Material Release Notice (CLM).

NOTE: Other examinations, assays, inspections and tests required in the contractual documentation shall be included in this list of Quality Records.


11. HANDLING, MOORING, PRESERVATION, STORAGE AND SHIPPING

11.1. The handling, mooring, preservation, storage and shipping requirements shall meet the design standard and additional requirements set out in the contractual documentation, throughout all stages of the execution process, storage and transportation of the product.

11.2. When applicable, stainless steel materials, nickel alloys or titanium alloys shall be stored, handled and processed according to the Supplier's specific procedures for each type of material in order to avoid the risk of contamination.

12. MANUFACTURING QUALITY AUDIT

Periodic audits may be carried out during the manufacturing process and there shall be considered, as a minimum, the following aspects, in addition to those defined in I-ET-0000.00-0000-972-1AL-001, as well as other requirements in the contract.

	SPECIFICATION	Nº I-ET-3000.00-1000-972-1AL-005	REV. B
			Sheet 15 de 15
	TITLE: COMPLEMENTARY QUALITY REQUIREMENTS OF FLEXIBLE PIPE AND ANCILLARY EQUIPMENT		PUBLIC
			QB

- a) Homologation of the prototype;
- b) Certification of inspectors (when applicable) or evidence of qualification/training;
- c) Analysis and approval of ITP;
- d) Holding of PMM;
- e) Qualification of Sub-supplier;
- f) Approval/qualification of manufacturing and inspection procedures;
- g) Identification and traceability control;
- h) Methodology of control and maintenance of standards and instruments of measurement and control;
- i) Evidence of compliance with all the technical requirements defined in the contractual standards and technical specifications;
- j) Verification of the manufacturing stages defined in the ITP, performance of the Guarantee System and quality control of the Supplier and the Responsible for the Manufacturing Inspection;
- k) Evidence of assembly and testing;
- l) Evidence of preservation, mooring and packaging;
- m) Evidence of treatment of nonconformities;
- n) Evidence of quality records and action plans.

NOTE: It shall also be verified in audits the inspection and testing activities performed at the Sub-suppliers throughout the manufacturing process of the Flexible Pipe and Ancillary Equipment (according to the ITP).