INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL
A	Maximum ovalization requirement added to Section 2.1 Pitch measurement requirement added to Section 3.1 New end fitting specification added and requirements adjusted in Section 6.2 Minimum leak test duration added to item 6.4
B	New requirements in Section 8 Manufacturing Tolerances

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G
DATE	18/12/2019	01/11/2021	31/07/2023					
PROJECT	SUB/ES/DCT	SUB/ES/DCT	SUB/ES/DCT					
EXECUTION	Walter (UQ9R)	Walter (UQ9R)	Walter (UQ9R)					
CHECK	Eder (CSN8)	Eder (CSN8) Gasparetto (BEJH)	Eder (CSN8) Gasparetto (BEJH)					
APPROVAL	Lancelotti (CXAX)	Lancelotti (CXAX)	Lancelotti (CXAX)					

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This Technical Specification is part of I-ET-3000.00-1519-291-PAZ-001 – Flexible Pipe Technical Specification. Please refer to the Flexible Pipe Technical Specification for instructions, definitions and abbreviations.

1. Quality Assurance Requirements

1.1. General

The manufacturing plant and manufacturing process shall also be verified and certified by the IVA. Each manufacturing plant shall be certified for a clear range of products supported by manufacturing runs and by the design methodology limits.

Automatic control during the product manufacturing should be adopted in order to check the quality of layers produced in continuous process.

1.2. Process Control

1.3. Handling During Manufacture

2. Carcass

2.1. General

The manufacturer shall establish, based on the design methodology, a criterion for maximum acceptable ovality after manufacturing.

2.2. Inspection and Acceptance Criteria

3. Polymer Extrusions

3.1. General

Carcass pitch shall be measured and documented immediately before the extrusion process to demonstrate that handling from the carcass manufacturing machine to the extruder has not caused the pitch to drift outside manufacturing tolerances.

3.2. Inspection and Acceptance Criteria

3.2.1. Visual Examination

3.2.2. Dimensional Measurements

Thickness and diameter of the internal pressure sheath and the outer sheath shall be continuously measured at a rate of at least 1 measurement per second. Thickness shall be measured at the bottom, at the top and at both sides of the layer cross section.

For the other extruded layers, thickness and diameter measurements shall be recorded at least every 10 m for the first 50 m at the same cross section positions as the internal pressure sheath. Subsequently, the thickness and diameter shall be measured and recorded at intervals verified by the manufacturer to be acceptable. Measurements shall be taken after the cooling process.

3.2.3. Test Requirements

If the pipe internal pressure sheath is polyamide 11 or polyamide 12, CIV shall be measured on the manufacturing run of the actual pipe to be supplied, according to procedure found in Appendix D of API 17TR2. For this purpose, measurements shall be performed in each extremity of any continuous run of the extruded internal pressure sheath, in 1 thickness position at 0.5 mm from the internal surface. The acceptance criteria is a CIV value equal or greater than 1.8 dl/g.

If PVDF is used in the internal pressure sheath, the manufacturer shall have a clear, validated criterion for surface finishing of the extruded layer. The manufacturing process shall be such that the limit values adopted shall demonstrate that no crack initiation or rupture of these layers will occur throughout the flexible pipe life cycle. A criterion regarding the surface condition of the internal pressure sheath in the end fitting sealing region shall also be established and validated.

The manufacturer shall monitor the extrusion process of the internal pressure sheath in order to guarantee that there are no internal defects such as bubbles, cracks and voids in the entire extruded layer.

4. Pressure and Tensile Armor Layers

4.1. General

For each manufactured pipe, the manufacturer shall calculate the stress and strain states of the Pressure and Tensile Armor layers. This data shall be presented in the As-Built Documentation.

4.2. Inspection and Acceptance Criteria

Pressure and tensile armor fishscaling shall be measured and recorded at least every 10 m for the first 50 m and subsequently at intervals verified by the manufacturer to be acceptable and during each stop/reversal cycle.

No radial gap between adjacent layers is accepted. This shall be demonstrated through design and control of the manufacturing process.

5. Antiwear, Insulation, and Antibuckling Tape Layers

5.1. General

5.2. Inspection and Acceptance Criteria

6. End Fitting

6.1. General

6.2. Assembly

End fitting assembly procedure shall comply with I-ET-3000.00-1519-291-PZ9-002 – General End Fitting Requirements. The manufacturer shall assure that the assembly process is controlled and that critical characteristics are recorded. Every step of the end fitting assembly process shall be documented in the as built data.

Special attention shall be given to the tack welding and fixing of the carcass in the End Fitting. The tack welding procedure shall be qualified and validated by an IVA and it shall demonstrate that no unspiraling of the carcass will occur if the flexible pipe annulus is flooded.

If heating is required for the folding and unfolding of the armors during end fitting assembly, the manufacturer shall demonstrate the temperatures reached during the heating process are controlled.

The wire former or guide used during the folding and unfolding of the armors shall be designed according to the validated end fitting wire anchoring methodology. The same applies to the control of the position of the wires inside the end fitting, including circumferential gaps and tolerances in shape. All end fittings shall be mounted with devices to control the bending radius, the tools used in each assembly shall be documented as part os the as-built data.

Any handling of the End Fitting prior to epoxy curing shall not result in movement or deformation of the wires inside the end fitting outside of the controlled and expected values according to the validated end fitting wire anchoring methodology. Mounting aids may be used to ensure the wires remain in position and videoscopy may be applied to check for wire movement.

If the proposed riser monitoring system influences the design of the end fitting, the manufacturer shall include any specific requirement in the product drawings and end fitting assembly procedure.

6.3. Inspection and Acceptance Criteria

6.4. Test Requirements

The sealing tightness of all ports and sealing interfaces of the end fitting shall be tested after assembly. As a minimum, all vent ports, epoxy injection ports, seal testing ports and sealed interfaces (e.g. between jacket and body) shall be leak tested considering the design water

depth and maximum predicted annulus pressure. Minimum test duration shall be 15 minutes and the tests shall be performed with N_2.

6.5. Connectors

6.6. Gas Relief Valves

Each valve shall be calibrated and its crack and reseat pressures shall be checked for at least 6 cycles of opening/closing. The valve inlet shall be subjected to pressurized air and the test shall be performed with a pressurization/depressurization rate of 0.5 bar/sec. The end of a cycle is defined as the point where no more bubbles are noticed. Crack and reseat pressures shall be measured at the end of each of the 6 cycles. For the 6 cycles, the specified crack pressure shall not change by more than ± 0.5 bar and the minimum reseat pressure shall be 2/3 of the cracking pressure. Alternative criteria for calibration may be used if previously accepted by Petrobras.

The manufacturer shall provide a certificate of calibration of each valve which content shall include the value of the measurements carried out, the series number and type of the valve, identify the instruments used in the measurements, their uncertainties, and their traceability with standard instruments.

6.7. Bend Stiffener

The manufacturer shall account for the requirements and recommendations concerning to materials and fabrication of bend stiffeners as found in I-ET-3010.00-1500-960-PPC-011 – General bend stiffener requirements.

Special attention shall be given to:

a) welding of structural components,

b) the grade of finishing of structural components after the grinding process, specially when these components are to be embedded by the bend stiffener polyurethane body,

c) surface preparation for assuring the bonding of structural components to the polyurethane body, wherever required in the design methodology, and

d) moulding and cure of the polyurethane body.

7. Processes Requiring Validation

7.1. Welding

7.2. Validation

7.3. Metallic Layers

Additionally, the manufacturer shall consider that the welding overlay procedures and

welder/weld operators shall be qualified as per ASME Section IX, Articles II and III and be inspected as per item 7.4 of ISO-10423.

7.3.1. Polymer Layers

7.3.2. End Fitting

7.4. Heat Treatment

7.5. Coating

Welding overlay procedures and welder/weld operators shall be qualified as per ASME Section IX, Articles II and III and be inspected as per API 6A.

Electroless Nickel Coating shall be qualified according to ET-3000.00-1500-950-PMU-001 – Revestimento de Níquel Químico com Tratamento Térmico de Interdifusão.

Coating for corrosion protection of end fittings and connectors surfaces shall be as per I-ET-3000.00-1500-956-PZ9-001 – Anticorrosive Coating for End Fitting and Connectors. Alternatively, Electroless Nickel Coating may be employed for all external surfaces as per ET-3000.00-1500-950-PMU-001 – Revestimento de Níquel Químico com Tratamento Térmico de Interdifusão.

8. Manufacturing Tolerances

Antibuckling Tapes shall have the tolerances specified for at least the following parameters: external diameter, number of layers, direction of application over the pipe body, pitch (or lay angle), and overlap (between adjacent layers).

The tolerance for the length of the flexible pipe (with end fittings assembled) shall be such that the flexible pipe section is not smaller than the design value and that it is no larger than the design value plus 10 meters for risers and 15 meters for flowlines. The total riser length shall not be exceeded by more than 20 meters. Smaller tolerances may be required for specific projects, in this case, target tolerances will be indicated in the project-specific documentation.

The tolerance for the pipe OD is ± 5 % of the nominal value submitted by the manufacturer to the purchaser in the design report.

If dimensional criteria are based on manufacturing considerations rather than design considerations, the manufacturer shall document that the criteria used meet the design requirements.

9. Repairs