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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 Goods General Requirement.


1.2. This Quality Requirement applies to subsea Flexible Pipe and Ancillary equipment's family of material.

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. ISO 9001 - Quality Management System – Requirements;
- 2.3. I-ET-3000.00-1519-291-PAZ-001 - Flexible Pipe Technical Specification;
- 2.4. API SPEC 17J - Specification for Unbonded Flexible Pipe;
- 2.5. API SPEC 17L1 - Specification for Ancillary Equipment for Flexible Pipes and Subsea Umbilicals;
- 2.6. I-ET-0000.00-0000-972-1AL-001 - Quality of Goods General Requirements (GQR);
- 2.7. ET-3000.00-1500-950-PMU-001 - *Revestimento de níquel químico com tratamento térmico de Interdifusão*;
- 2.8. I-ET-3000.00-1500-956-PZ9-001 - Anticorrosive Coating for End Fitting And Connectors;
- 2.9. I-ET-3000.00-1500-251-PEK-001 - High-Strength Low-Alloy Steel Fasteners for Subsea Application;
- 2.10. ET-3000.00-1500-251-PEK-002 – *Rastreabilidade de Fixadores de Alta Resistência para Utilização Submarina*;
- 2.11. ET-3000.00-1500-941-PMU-003 - *Padronização de Acessórios para Kit Pull-In*;
- 2.12. I-ET-3010.00-1500-960-PPC-011 – General Bend Stiffener Requirements;
- 2.13. I-ET-3000.00-1519-291-PZ9-002 – General End Fitting Requirements;

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- 2.14. I-ET-3010.00-1500-960-PPC-014 - Spyhole End Fitting;
2.15. PETROBRAS Standard N-2941 - Personal Competencies for Inspection Activities.

NOTE 3: 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 4: The edition/revision of the documents applicable to the project is that defined in the contractual documentation, if not specified, the current edition/revision on the date of signature of the contract applies.

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 (RMI) for each Flexible Pipe and its Ancillary Equipment.

NOTE 5: 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 RMI.

- 4.2. Manufacturing monitoring for all Flexible Pipes and their critical components, as detailed in the items below.
- 4.2.1. 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:
- a) Final inspection of ancillary equipment before assembling on Flexible Pipe;

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- b) Inspection steps for connectors assembly on the Flexible Pipe,
- c) Inspection of the tensile armor inside the connector by videoscopy (when technically applicable), according to I-ET-3000.00-1519-291-PZ9-002;
- d) Connector seal test;
- e) Factory acceptance tests - FAT;

NOTE 6: In the FAT follow-up, all activities defined in the design standard shall be considered.

- f) Adhesion tests of identification paint and marking on the outer sheath;
- g) Verification of marking and identification of the Flexible Pipe;
- h) Packing and final mooring of the Flexible Pipe and ancillary equipment;
- i) Verification of manufacturing technical documentation book (data book of the flexible pipe and its ancillary equipment);
- j) Rework/repairs that are not according to design condition or contractual specification.


4.2.2. 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 7: Special attention to the expiration date of the polymers.

- b) Verification of compliance 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 tensile armor layers, in particular the HIC and SSC tests;
- d) Verification/approval of the treatment contained in the nonconformities issued by the Supplier;
- e) Verification of the qualification approval for the Flexible Pipe structure before issuing the CLM (MRN). In cases where there are pending issues, when the structure is not qualified, the supplier shall obtain authorization from PETROBRAS Engineering for the release of the material.

4.2.3. 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:

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- a) Manufacturing process of all layers;
- b) Collection of specimen for CIV (corrected inherent viscosity) of internal sheath in PA;
- c) Spark test in the internal pressure sheath, prior to the installation of the pressure armor;
- d) Welding processes of pressure armor, tensile armor and carcass (when applicable);
- e) Epoxy compression test;
- f) Nondestructive testing.

4.2.4. The Responsible for the Manufacturing Inspection shall consider, at least, the following steps as Hold Points at Supplier/Sub-supplier, which shall be set out in the ITP of ancillary equipment:


- a) Top Bend Stiffener: visual and dimensional examination, factory acceptance tests, review of the technical documentation and other requirements as per API SPEC 17L1 and I-ET-3010.00-1500-960-PPC-011;

NOTE 8: 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, factory acceptance tests and document review of the other components, such as connectors, metal rings joints, bend restrictors and buoyancy module, considering requirements of API SPEC 17L1 and the Technical Specifications listed below:

- ET- 3000.00-1500-950-PMU-001- *Revestimento de níquel químico com tratamento térmico de Interdifusão*;
- I-ET-3000.00-1500-956-PZ9-001 - Anticorrosive Coating for End Fitting And Connectors;
- I-ET-3000.00-1519-291-PZ9-002- General End Fitting Requirements;
- I-ET-3010.00-1500-960-PPC-014 - Spyhole End Fitting;
- ET-3000.00-1500-941-PMU-003 - *Padronização de Acessórios para Kit Pull-In*.

- c) Verification of the book of technical documentation of manufacture (data book) of all the ancillary equipment.

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NOTE 9: The steps defined previously can be performed at the Supplier's facility or elsewhere, if they could be able to carry out all the verifications/trials/tests foreseen.

4.2.5. The Quality Control for the manufacture of fasteners (bolts, cases and nuts) used in the accessories/components listed below, which are exposed to cathodic protection, shall meet the requirements defined in the technical specifications I-ET-3000.00-1500-251-PEK- 001 and I-ET-3000.00-1500-251-PEK-002:


- API Flange;
- Anchoring Collars
- Top Bend Stiffener;
- End Fitting Rear Flange.

4.2.6. 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 INSPECTORS

5.1. The Responsible for Manufacturing Inspection (RMI) shall comply with PETROBRAS standard N-2941 in the IF-TF modality or its equivalent abroad to directly participate in the manufacturing and assembly activities of the Submarine Flexible Pipe. Additionally, for the inspection of ancillary equipment, certifications in the IF-PP, IF-CT, and IF-AT modalities or their equivalents abroad can be used, according to the characteristics of the item to be inspected.

5.2. The Responsible for Manufacturing Inspection (RMI) of a facility exempt from hiring an Accredited Inspection Body (AIB) can carry out inspections at Sub-suppliers. If the supplier chooses to carry out the manufacturing inspection at Sub-suppliers through an inspection company, it shall meet the AIB requirements established by the GQR.

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6. INSPECTION PLANNING

6.1. PRE INSPECTION MEETING - PIM

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

NOTE 10: This meeting can include more than one purchase order (PC) or contract, since they have the same contractual technical designs, structures, requirements and specifications.

NOTE 11: In case the purchase order or contract presents the same projects, structures, requirements and specifications already evaluated and discussed in other PIM (previously performed and related to the same contract), the same RMI and the same manufacture site, it is at the Supplier's discretion to hold a new PIM meeting. If Supplier decided to not holding this meeting, the RMI shall register that the same definitions discussed and validated in previous PIM are applicable and forward monthly this information to PETROBRAS via CSE.


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 plan for the product manufacturing, from placing the purchase order up to its delivery. This planning shall be focused on the inspection and tests pointed out in the ITP of Subsea Flexible Pipe and its ancillary equipment.

6.2.2. This planning shall be submitted for the acknowledgement and comments of the RMI 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.

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6.3.2. The Supplier shall select and evaluate its Sub-suppliers in accordance with the requirements of ISO 9001, of the Quality of Goods 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.

7. INSPECTION AND TEST PLAN


7.1. An ITP shall be prepared for each structure of 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 RMI shall define, upon the ITP approval, for each structure of Flexible Pipe, the extent of its participation on the inspections and tests to be performed at the Supplier's facilities, covering the inspection activities set out in ET-0000.00-0000-972-1AL-001, in this Complementary Requirement and other contractual documents.

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.

7.4. In compliance with and complementing API SPEC 17J and 17L1 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) Certificates and traceability of raw material review;
- 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) Welding process of the metallic layers verification;

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- e) Nondestructive testing verification;
- f) PMI verification in alloy steels;
- g) Visual inspection of bottom / top connectors;
- h) Final inspection of ancillary equipment;
- i) Verification of the assembly of the connectors and assembly quality assurance test;
- j) Final inspection of ancillary equipment assembly;
- k) Verification and inspection of repairs;
- l) Factory Acceptance Test - FAT;
- m) Checking / identifying marking and final dimension of the Flexible Pipe;
- n) Final verification of Flexible Pipe;
- o) Packaging of ancillary equipment and spare parts;
- p) Check of packing and final mooring of the flexible pipe and ancillary equipment;
- q) Verification of manufacturing technical documentation book (data book of flexible Pipe and ancillary equipment);
- r) Verification of approval of the qualification of the structure.

8. PERSONNEL AND PROCEDURES QUALIFICATION

8.1. PERSONNEL QUALIFICATION

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


8.1.1. 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.

8.2. PROCEDURES QUALIFICATION

8.2.1. The Supplier shall qualify and approve the following procedures by PETROBRAS standard N-2941 certified professionals before the beginning of the respective activity:

- a) Radiography;
- b) Ultrasound;

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- c) Penetrating liquid;
- d) Magnetic particles;
- e) Visual;
- f) Hardness;
- g) Welding;
- h) Repair;
- i) PETROBRAS standard paint.

NOTE 12: 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 reviewed by the RMI 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 shall be met:

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

9.2. WELDING PROCESS

9.2.1. The welding documentation shall be available for verification by the RMI, when applicable or required in the project, before performing the inspection and test activity according to ITP.


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9.3. INSPECTION AND TESTING ACTIVITIES

9.3.1. During the manufacturing process, the following documents shall be available for verification by the RMI 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 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;
- 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 (FAT) procedure;
- 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 RMI.


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

10. QUALITY RECORDS AND DATA BOOK

In addition to the documents required by the API SPEC 17J and 17L1, as a minimum, the following documents shall be issued and made available by the Supplier, reviewed and approved by the RMI and included in data book:

- 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 reports provided according to the ITP and drawings;
- d) Nonconformity reports containing the respective treatment by the Supplier, corrections and corrective actions;
- 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. Only the assembly compliance record shall be included in the data book;
- l) Report of assembly of ancillary equipment. Only the assembly compliance record shall be included in the data book;
- m) Factory acceptance test report of Flexible Pipe and if applicable, ancillary equipment;
- 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) Other quality and inspection records indicated in the ITP. They shall be included in the data book if requested by PETROBRAS.

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NOTE 13: Other examinations, assays, inspections and tests required in the contractual documentation shall be included in data book.

NOTE 14: Calibration certificates for the instruments used during the quality control process do not need to be attached to the data book when the supplier has a system for verifying the traceability and validity of instrument calibrations.

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 process execution, 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.

- a) Homologation or qualification of the Flexible Pipe structure and components;
- b) Certification of inspectors and qualification/training evidences;
- c) Analysis and approval of ITP;
- d) Holding of PIM;
- 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;

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- j) Verification of the manufacturing stages defined in the ITP, performance of the Quality Management System 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 15: 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).

13. TREATMENT OF NON-CONFORMITIES

- 13.1.** Additionally, to what is defined in ET-0000.00-0000-972-1AL-001, the supplier shall send to the Quality Goods department, within 5 business days, the non-conformities classified as medium related to the final acceptance tests of manufacturing.
- 13.2.** The supplier shall maintain a control of all non-conformities generated during manufacturing.
- 13.3.** The supplier shall present monthly to the Quality Management of PETROBRAS a control of manufacturing non-conformities classified as medium, severe, or high. The control shall include the necessary updates, investigation timelines, and an executive summary with the root cause analysis, corrective actions, photos, effectiveness, and scope of the actions. This control shall include traceability of the pipe, purchase orders, and contracts.

14. QUALITY MONITORING

- 14.1.** Quality meetings shall be held between PETROBRAS and the Supplier with the objective of monitoring the progress of deliveries at all manufacturing facilities that produce equipment with Q-type inspection.
- 14.2.** The meetings should follow a minimum agenda, as outlined below:
 - a) Presentation of the scope of supply by manufacturing facility;
 - a) Pending project qualification issues;
 - b) Quality management and performance evaluation of the main sub suppliers;

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- c) Main manufacturing non-conformities in the period, segregated by process and their respective mitigation actions;
- d) Non-conformities identified after delivery and COD, mainly those that had developments related to equipment design revisions and/or adjustments in manufacturing processes;
- e) Monitoring of audit non-conformities;
- f) Schedule of planned tests for the next 60 days for critical equipment;
- g) Clarification of doubts regarding quality requirements and other contractual technical requirements.

14.3. The frequency and agenda of the meetings should be adjusted throughout the supply process, according to the needs of PETROBRAS and the Supplier.

14.4. PETROBRAS can conduct, at any time, regardless of the events established in the ITPs, quality monitoring at the suppliers' and sub suppliers' facilities with the objective of verifying the compliance of manufacturing, inspection, and testing processes with contractual requirements and internal procedures of the supplier and its sub suppliers.

14.5. During the manufacturing monitoring, the Supplier shall provide a suitable location for the PETROBRAS team.


14.6. During the manufacturing monitoring, PETROBRAS shall have access to the areas involved in the manufacturing processes, documents, and applicable procedures.

14.7. PETROBRAS can adopt verification lists based on contractual requirements and internal procedures of the supplier.

14.8. The supplier shall make representatives from the manufacturing sectors available during the manufacturing monitoring activities.

14.9. The frequency and/or extent of the manufacturing monitoring activity will be defined by PETROBRAS, considering, among other aspects, the criticality of the item for operation, complexity of the manufacturing process, supply portfolio, occurrence of divergencies in delivered equipment, and performance indicators.

14.10. Deviations found during quality monitoring activities shall be recorded and addressed as provided in the supplier's quality management system.

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15. DISPENSATION OF HIRING THE AIB

15.1. In addition to what is defined in the GQR, for the supplier to be exempt from hiring AIB at a specific manufacturing facility, the criteria below shall be fully met, including components supplied by sub suppliers:

- a) No severe or high non-conformity detected in the audit, as defined in Table 1 of the GQR;
- b) No severe or high non-conformity detected in quality monitoring, as defined in Table 1 of the GQR;
- c) Not having more than 03 (three) open CODs simultaneously, provided there are no pending issues by PETROBRAS regarding the availability of the equipment for the investigation process, if necessary.

15.2. In case of losing the exemption from hiring AIB at the facility where the item is manufactured, the supplier is required to hire the AIB for a minimum period of 12 months or until the divergencies are resolved, whichever is greater.