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## 1. INTRODUCTION

This Technical Specification establishes the main parameters for BELL MOUTHS supplying and describes the criteria for manufacturing, inspection and acceptance tests.

## 2. OBJECTIVE

The objective of this document is to define the Technical Specification (TS) for the supplying of DIVERLESS BELL MOUTHS – BSDL model manufactured in carbon steel for equipping I-TUBE of 32”, 46” and 48” nominal diameter, providing protection for umbilicals and flexible risers.

## 3. DEFINITIONS

### 3.1. General

For the purposes of this document, the following terms and definitions apply. Other terms and definitions can be found in reference documents and standards.

### 3.2. Definitions

#### 3.2.1. Bell Mouth

BELL MOUTH is a device used for supporting and locking bend stiffeners for flexible risers.

#### 3.2.2. Bend Stiffener

Bend Stiffeners are conically shaped polyurethane mouldings designed to add local stiffness to a riser, flowline, cable or umbilical

#### 3.2.3. Cap DL

Bend Stiffener’s metallic component that provides alignment of this equipment inside the BELL MOUTH, containing an interface geometry for the locking system (Latch Bars).

#### 3.2.4. Cenpes

Petrobras Research and Development Center.


#### 3.2.5. Contractor

Company that runs the services or manufacturing contract of a SPU and hires the services for manufacturing of the BELL MOUTH.

#### 3.2.6. Diverless Bell Mouth - BSDL

It is a BELL MOUTH designed to allow pull-in operations without diver assistance.

#### 3.2.7. Dummy Cap

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Mechanical part used to simulate the introduction and the locking of Bend Stiffener's Cap DL into the BELL MOUTH.

### 3.2.8. FPSO

Floating Production Storage and Offloading.

### 3.2.9. Handlers

Handlers are sets including a lever and a cam that are used in the latch bar locking mechanisms.

### 3.2.10. NDT

Non-Destructive Testing

### 3.2.11. Pull-in

Riser transfer operation from installation ship to the SPU.

### 3.2.12. Pull-out

Riser removal operation.

### 3.2.13. Riser

A length of flexible or rigid pipe used to connect the subsea collecting/exporting system to the SPU.

### 3.2.14. SPU

SPU – Stationary Production Unit – is a ship or a semi-submersible platform for oil and gas production. The FPSO is a type of SPU.

### 3.2.15. Supplier

Company responsible for manufacturing the BELL MOUTH.

### 3.2.16. Test Record Sheet – TRS

Test Record Sheet is a document used to register each step of BELL MOUTH tests.

### 3.2.17. Testing Stand

Testing Stand is a test bench used to simulate the fastening of the BELL MOUTH on the I-Tube.

## 4. REFERENCE DOCUMENTS AND STANDARDS

BELL MOUTH's manufacturing shall be in accordance with the following documents and standards in their latest revisions, unless otherwise indicated.



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#### 4.1. International Standards

**ASTM A370** – Standard Tests Methods and Definitions for Mechanical Testing of Steel Products;

**ASTM A517** – Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered;

**ASTM A578** – Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications;

**ASTM B841** – Standard Specification for Electrodeposited Coatings of Zinc Nickel Alloy Deposits

**AWS D1.1** – American Welding Society Structural Welding Code;

**EN 473** – Qualification and certification of non-destructive testing personnel – general principles;

**ISO 2859** – Sampling Procedures for Inspection by;

**ISO 8501** – Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness;

**ISO 8504** – Preparation of steel substrates before application of paints and related products – Surface preparation methods;

**ISO 9001** – Quality management systems – Requirements;

**ISO 9712** – Non-destructive testing - Qualification and certification of NDT personnel;

**ISO/IEC 17024** – Conformity assessment – General requirements for bodies operating certification of persons;

**ISO/IEC 17020** – Conformity assessment – Requirements for the operation of various types of bodies performing inspection;


**ISO GUIDE 65** – General Requirements for Bodies Operating Product Certification Systems;

**SSP-SP1** – Solvent Cleaning;

**SSPC-SP10** – Near-White Metal Blast Cleaning.

#### 4.2. References and Standards for services in Brazil

In addition to the standards in 4.1, in order to perform services in Brazil, supplier shall meet the requirements in the following documents and standards in their latest revisions, unless otherwise indicated.

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**ABENDI NA 018** – “Qualificação e certificação de pessoas em teste por pontos” (Qualification and certification of persons for chemical spot testing);

**ABNT NBR 14842** – “Critérios para a qualificação e certificação de inspetores de soldagem” (Criteria for welding inspector qualification and certification);

**ABNT NBR 15218** – “Critérios para qualificação e certificação de inspetores de pintura industrial” (Industrial paint inspectors - Rules for qualification and certification);

**ABNT NBR 16278** – “Inspeção de fabricação — Qualificação e certificação de pessoas para o setor de petróleo e gás” (Manufacturing inspection — Qualification and certification of personnel for the oil and gas sector);

**ABTN NBR 5426** – “Planos de amostragem e procedimentos na inspeção por atributos” (Sampling Procedures for Inspection by Attributes);

**ABNT NBR NM ISO 9712** – “Ensaio não destrutivo – Qualificação e certificação de pessoal” (Non-destructive testing – Personnel qualification and certification);

**PETROBRAS N-1859** – “Qualificação de Consumíveis de Soldagem” (Qualification of Welding Consumables);

**PETROBRAS N-2301** – “Elaboração da documentação técnica de soldagem” (English - Elaboration of technical documents for welding);

**PETROBRAS PP-5EN-00008** – “Ensaio não destrutivo – qualificação de pessoal” (Non-destructive testing – personnel qualification).

## 5. DOCUMENTATION

### 5.1. Bidding documentation

5.1.1. Contractor before proposal delivery shall inform conflicting data present in Petrobras drawings. If any problem is identified during manufacturing phase, the solution taken by Contractor SHALL NOT penalize Petrobras at any circumstance.

### 5.2. Manufacturing documentation


5.2.1. Supplier shall generate its own drawings, according to its manufacturing methodology, and shall submit them to Contractor for analysis and approval.

5.2.2. Contractor shall be attentive to the revision of the manufacturing drawings provided by the Supplier. In case of doubts, Cenpes shall be consulted through Petrobras representative.

5.2.3. The Supplier shall only start manufacturing the BELL MOUTH after approval of manufacturing drawings by the Contractor.

### 5.3. Dummy Cap drawing

5.3.1. Defines the Dummy Cap to be used in factory acceptance test.

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5.3.2. I-DE-3010.00-1300-279-PPC-323 – specify the Dummy Cap to the BSDL model.

## 6. BELL MOUTH IDENTIFICATION AND TRACEABILITY

### 6.1. Bell Mouth Identification

- 6.1.1. The BELL MOUTH set shall be marked with a numeric identification referring to the slot on the platform where it will be installed.
- 6.1.2. Supplier shall apply the identification number on the external surface with a minimum height equal to 200mm (two hundred millimeters) and shall paint it with a color contrasting to the color of the base, in such a way it can be easily visible by remote filming with video.
- 6.1.3. Supplier shall apply the identification number in four sectors spaced by 90 degrees, allowing its reading and identification from any visual angle.
- 6.1.4. A linear weld bead shall be done following the design center of each digit. The supplier shall ensure that the heat input during welding does not change the mechanical properties of the basic material.

### 6.2. Traceability

- 6.2.1. Codification and traceability procedures shall be in accordance with item 7.5.3 of ISO 9001 plus the following requirements:
- 6.2.2. Alphanumeric codes for traceability shall be punctured in materials using low stress punches.
- 6.2.3. Each equipment shall receive a unique codification in order to allow tracing back its respective inspection and tests reports.

## 7. PROTECTION AND PACKING

### 7.1. General

- 7.1.1. BELL MOUTHS shall be delivered packed to ensure the integrity of the parts, in special of the mobile locking devices.

## 8. MATERIALS AND COMPONENTS

### 8.1. General

- 8.1.1. Supplier shall provide material certificates of raw materials used in BELL MOUTH manufacturing to be included in the data book, as in item 18 of this specification.


### 8.2. Ferrous Materials

- 8.2.1. Ferrous materials used to manufacture the cylindrical body, latch bars and springs shall be certified by a classification society.

### 8.3. Spring

- 8.3.1. Supplier shall be attentive to the material defined in spring's drawing I-DE-3010.00-1300-279-PPC-310.



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#### 8.4. Thermally Pretreated Steels

8.4.1. Parts manufactured with thermally pretreated steels may need heat treatment after welding and/or machining for ensure that its mechanical properties will remain unaltered. Supplier shall contact the supplier of the steel to specify the appropriate heat treatment.

#### 8.5. Materials Testing

8.5.1. When using thermally pretreated steel in the manufacturing of latch bars, if the material suffer any manufacturing process that can alter its mechanical properties (such as, but not limited to, cutting with blowtorch), the manufacturer must ensure that the properties of the finished material remain similar to the properties of raw material.

8.5.2. Supplier shall manufacture an additional latch bar by batch of steel plate used. This additional latch bar shall be heat-treated along with the latch bars that will be used in the assembly of the BELL MOUTH.

8.5.3. Destructive testing shall be performed on this additional latch bar to estimate the mechanical properties of the remaining latch bars. The results shall meet the contractual specifications and shall be part of Data Book, as in section 18 of this specification.

### 9. PROCEDURE AND PERSONNEL QUALIFICATION


#### 9.1. Requirements for personnel qualification and certification

9.1.1. The Supplier shall meet the following personnel qualification and certification requirements:

9.1.1.1. **Inspectors for non-destructive testing** – in order to perform visual, liquid penetrant, magnetic particle, radiographic, ultrasonic, and eddy current testing in Brazil, qualification and certification shall be according to the Brazilian System of Personnel Qualification and Certification in NDT – ABENDI, in conformity with standard ABNT NBR NM ISO 9712. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in standard ISO/IEC 17024 and that operate in conformity with standards ISO 9712 or EN 473;

9.1.1.2. **Welding inspectors** – in order to perform welding inspection in Brazil, qualification and certification shall be by the Brazilian System of Welding Inspector Qualification and Certification (FBTS), according to standard ABNT NBR 14842. For level 2 inspectors, this FBTS qualification and certification shall be in the main applicable standard. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in standard ISO/IEC 17024, and for level 2 inspectors, in the main applicable standard as well.

9.1.1.3. **Customer fabrication inspectors** – in order to perform customer fabrication inspection in Brazil, in the modalities presented below, qualification and certification shall be by PETROBRAS/ETM-CORP/ST/SEQUI-ETCM, according

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to ABNT NBR 16278. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in standard ISO/IEC 17024. For services rendered abroad is acceptable also, as an alternate route for ISO/IEC 17024, that the inspection shall be performed by Inspection Bodies accredited by National Accreditation Bodies that are members of IAF-International Accreditation Forum. The Inspection Bodies shall be accredited in accordance with ISO/IEC 17020 type A, for the same Field of Inspection (e.g.: Boilers and pressure vessels) and Methods and Procedures (e.g.: ASME VIII - Rules for the construction of pressure vessels; ASME/ANSI B 31.1 and 31.3, Power and process piping and associated systems, materials and components) considered for the customer inspection to be carried out.

- piping accessories;
- metallic equipment, structures, boilers and piping;
- mechanics;
- oil drilling and production;
- offshore mooring and loading;
- flexible pipes and umbilicals.

9.1.1.4. **Painting inspectors** – in order to perform painting inspection in Brazil, qualification and certification shall be the Brazilian System for Qualification and Certification of Personnel on Corrosion and Protection (ABRACO), according to ABNT NBR 15218. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in standard ISO/IEC 17024;

9.1.2. Regarding qualification of welders and welding operators, the Supplier shall meet the following directives:

9.1.2.1. Welders and welding operators shall be qualified by a level 2 welding inspector, according to the equipment project standard. If the qualification standard of these professionals is not foreseen in the specifications, standard ASME Section IX shall be used for this purpose. Tackers are not allowed to be used, even when qualified according to technical standards;


9.1.2.2. For services in Brazil, welders or welding operators who have been performing welding activities without interruption for over three months, and were qualified for other jobs at Petrobras, can be used, so long as they present qualification records according to Petrobras N-2301, accompanied by their respective individual certificates (original documents), properly approved by a qualified welding inspector and endorsed by Petrobras Inspection of previous jobs;

9.1.3. The Supplier shall present to Inspection, before beginning of activities, the list of operators and inspectors qualified to perform and inspect the services.

## 9.2. Requirements for Procedure Qualification

9.2.1. The Supplier shall qualify the following procedures for non-destructive testing, before the beginning of activities:

- a) Ultrasonic Testing;

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- b) Liquid Penetrant Testing;
- c) Magnetic Particles Testing;
- d) Visual Testing;

9.2.2. Procedures presented above shall be qualified according to corresponding standards and certified by a level 3 inspector, with qualification and certification established in 9.1.1.

9.2.3. Welding procedures shall be qualified and certified before the beginning of activities, according to the following specifications:

9.2.3.1. For services rendered in Brazil by a level 2 welding inspector, qualified and certified in the main standard applicable. Qualification and certification shall be by the Brazilian System of Welding Personnel Qualification and Certification – FBTS, according to standard ABNT NBR 14842, or;

9.2.3.2. Welding services rendered abroad by qualified and certified welding inspectors, shall be also in the main applicable standard by independent international entities that meet requirements in standard ISO/IEC 17024.

## 10. WELDING

### 10.1. General

10.1.1. All welds shall be in accordance with American Welding Society (AWS) Structural Welding Code - Steel, AWS D1.1.


### 10.2. Qualification

10.2.1. The welders and welding procedures shall be qualified and certified in accordance with item 9 of this technical specification.

### 10.3. Welding Consumables

10.3.1. Consumables used in Brazil shall be certified by the Product Certification Body (OCP) as a Conformity Assessment Body (OAC) accredited by INMETRO under the *Sistema Brasileiro de Avaliação de Conformidade* (SBAC), according to Petrobras N-1859. When used abroad, they shall be certified by an OCP accredited by INMETRO or a foreign OCP that complies with ISO GUIDE 65. In this case, the consumable trademark does not comprise an essential variable in the qualified procedures. In case the welding consumables are not certified by the OCP, the change in consumable trademark, even if this does not modify its classification, results in the requalification of the welding procedure.

10.3.2. Once the consumables with suffix G are not certifiable by OCP, their use shall be limited to situations in which there is no specific classification to optimize a characteristic required for welding of a given material. If their use is required, the Welding Procedure Specification (WPS) and Welding Procedure Qualification Record (RQPS) shall clearly contain: trademark, specified chemical composition of deposited weld metal, specific toughness requirements (testing temperature and impact energy), and post-weld condition (as welded or treated). In addition, it shall have lot control, according to AWS A5.01 Schedule J. The welding of that consumable shall be used only with previous approval of Contractor. The

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respective lot certificates shall present the values specified and accepted by Contractor. For use of consumables generically classified (which means, equivalent to suffix "G") with specification different from AWS, such as, for example, of European standard (EN) or standard ISO, (only allowed when provided in the design standard of equipment), the same requirements described herein for suffix "G" consumables of specification AWS shall be met.

#### 10.4. Heat treatment

10.4.1. Heat treatment for stress relief shall be performed in the BELL MOUTH structural body in order to avoid elliptical shape.

### 11. MANUFACTURING INSPECTION

#### 11.1. General

11.1.1. The Contractor shall maintain a fabrication inspector during manufacturing process of the BELL MOUTH.

11.1.2. All inspection records and results shall be included in the data book.

11.1.3. Inspections shall be performed in accordance with specific procedures and shall include at least the activities listed in 11.2 to 11.8.


#### 11.2. Inspection and Tests Plan – ITP

11.2.1. Contractor shall define the extent of his participation in the monitoring of inspections and factory tests through an Inspection and Test Plan – ITP – to be prepared and submitted by Supplier.

11.2.2. Supplier shall send the ITP for Contractor approval respecting the contractual terms.

11.2.3. The ITP is a document within the Supplier's Quality Plan that follows the standards set by quality management standards, which shall contains at least:

- a. A description of activities of the manufacturing process, including those carried out in sub-suppliers, indicating the types and extent of exams, tests or checks to be performed during the manufacturing process;
- b. Identification of intervention type that will be performed by Supplier's personnel and by Contractor's inspection representative throughout the manufacturing cycle (document verification, monitoring point, observation point and holding point);
- c. Indication of procedures, technical specifications and standards for each activity;
- d. Acceptance criteria for all features and quality requirements of each activity, including activities carried out at sub-supplier facilities;

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e. Identification and preparation of quality records, citing the record type applicable to each activity.

### 11.3. Preparation and cutting

- 11.3.1. Verify if parts to be cut are identified in accordance with item 6.2 of this Technical Specification.
- 11.3.2. Verify if materials certificates correspond to the specified ones in the drawings.
- 11.3.3. Verify if parts dimensions are in accordance with drawings.

### 11.4. Pre-assembly

- 11.4.1. Verify if traceability of the parts is in accordance with item 6.2 of this specification and belong to the same assembly.

### 11.5. Nondestructive tests

- 11.5.1. All procedures and personnel used in NDT shall be qualified and certified in accordance with item 9 of this technical specification.
- 11.5.2. Visual inspection - All welds shall be inspected in 100% (both sides) of their extension to check aspect and continuity.
- 11.5.3. Liquid penetrant inspection – All welds shall be inspected in 100% of their extension.
- 11.5.4. Magnetic particle inspection - Shall be performed in union welds: cylindrical body vs. conical structure and cylindrical body vs. flange.
- 11.5.5. Ultrasonic inspection – Shall be performed in 100% of the butt joints with full penetration between the flange and the BELL MOUTH structure and in 100% of the plate used to manufacture the latch bars, before cutting them.
- 11.5.6. Surface finishing of all latch bars shall be in accordance with the drawings. The tests records shall be part of Data Book, as in item 18 of this specification.
- 11.5.7. Hardness shall be verified on all latch bars and shall be 32HC maximum. The tests records shall be part of Data Book, as in item 18 of this specification.

### 11.6. Tensile and Impact Tests

- 11.6.1. One latch bar shall be used to prepare 2 (two) samples for the tensile tests and 2 (two) samples for the impact tests. See Figure 1 and ASTM A370 for samples dimensions.
- 11.6.2. The samples shall be extracted after latch bars heat-treatment.
- 11.6.3. A Test Inspection and Certification Society (TIC-Society) shall certify the tests results.
- 11.6.4. The results shall be part of Data Book, as in item 18 of this specification.
- 11.6.5. Tensile Tests
  - 11.6.5.1. The yield strength, tensile strength, stretching and area reduction shall be obtained by tensile test.

11.6.5.2. The yield strength shall be 500 (five hundred) MPa minimum.

11.6.6. Impact Test

11.6.6.1. Charpy tests shall be performed at -10 °C (minus ten degree Celsius).

11.6.6.2. The result shall be 27 (twenty-seven) Joules minimum.

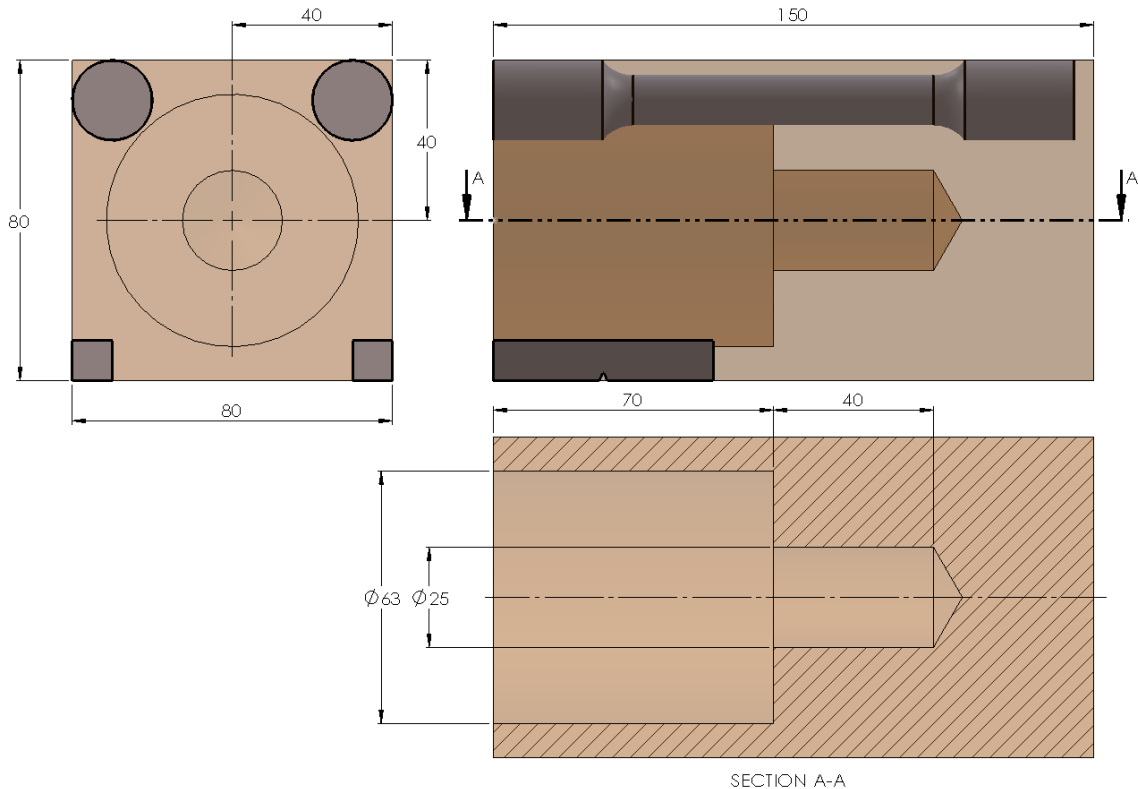


Figure 1 - Position for extraction of tensile and impact tests samples.

## 11.7. Dimensional

11.7.1. Verify if dimensions are in accordance with the drawings.


11.7.2. Dimensional control inspectors shall be qualified in accordance with item 9 of this technical specification.

## 11.8. Availability of documents for inspection

11.8.1. The Supplier shall keep available for the inspectors at all times the ITP, procedures, technical standards and other documents necessary to perform the inspection and interpretation of results.

## 11.9. Nonconformities

11.9.1. All non-conformities records shall be part of the data book, as in item 18 of this specification.

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## 12. CATHODIC PROTECTION

### 12.1. General

12.1.1. The BELL MOUTH cathodic protection is provided by the cathodic protection of the I-tube structure of the SPU.

## 13. PAINTING

### 13.1. General

13.1.1. Supplier shall observe that parts whose drawings present the indication "DO NOT PAINT" are not to be either painted or electrically isolated.

13.1.2. Painting procedure shall comply with item 13.2 or paint manufacturer specification. In case of divergence, paint manufacture specification shall be used, observing the thickness specification for each layer and final thickness.

### 13.2. Finishing and anti-fouling painting

#### 13.2.1. Surface preparation

13.2.1.1. All surfaces shall be free of oil, grease and salt contamination before blasting. Abrasive blast clean to Sa 2 ½ ISO 8501 or SSPC-SP10. If oxidation occur between blasting and paint application, the surface shall be re-blasted to the specified visual standard. Surface defects revealed by the blast cleaning process shall be ground or corrected in the appropriate manner.

13.2.1.2. Anchor profile: A sharp, angular surface profile of 50-75 microns (2-3 mils) is recommended.

13.2.1.3. Salt Contamination: Surface salts concentration (e.g. Chloride deposits) shall be less than 70 milligrammes/m<sup>2</sup> (or 7 microgrammes/cm<sup>2</sup>) prior to painting.

13.2.1.4. All surfaces to be coated shall be clean, dry and free of contamination. Prior to paint application all surfaces shall be assessed and treated in accordance with ISO 8504. Oil or grease shall be removed in accordance with SSPC-SP1 solvent cleaning.


#### 13.2.2. Epoxy Paint

13.2.2.1. Apply two coats of High Abrasion Resistant Aluminum Epoxy Paint Cured with Polyamine, with a minimum dry film thickness of 125 microns per coat, using airless spray gun. Interval from one coat to the next shall be at least 7 (seven) hours or at most 14 (fourteen) days.

#### 13.2.3. Sealant Paint

13.2.3.1. Seven (7) hours to fourteen (14) days after applying second coat of primer, apply one coat of intermediate bi-component coal tar free epoxy, with a minimum dry film thickness of 100 microns, using airless spray gun. Interval from one coat to the next shall be at least 4 hours.

#### 13.2.4. Antifouling Paint

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13.2.4.1. Apply two coats of copper free, self polishing copolymer (SPC) antifouling paint, resistant to 10 Years of immersion in maximum current of 3 knots, with a minimum dry film thickness of 125 microns per coat, using airless spray gun.

### 13.3. Final thickness

13.3.1. The maximum thickness of the painting after application of finishing and antifouling layers shall not exceed 0.6mm.

### 13.4. Final Painting

13.4.1. The BELL MOUTH shall be delivered with the paint free of defects.

13.4.2. For the FAT, BELL MOUTH shall be painted with the last layer of paint applied (antifouling). If any BELL MOUTH component is not in its final painting, such fact shall be reported, the tests shall be postponed and the painting of the parts shall be finished.

13.4.3. After FAT, painting shall be touched up to remove any risks and defects caused by the test. Final Thickness shall not exceed that required in item 13.3 of this specification.

13.4.3.1. If necessary, the paint shall be touched up only in parts that do not require disassembly of the locking mechanisms. If Supplier need to disassemble the locking mechanisms, the BELL MOUTH shall be retested.

### 13.5. Anti-friction coat

13.5.1. Apply one coat of PTFE finishing with a minimum dry film thickness of 25 microns in parts whose drawings specify this type of coating.

## 14. DUMMY CAP

### 14.1. General

14.1.1. Only one Dummy Cap must be manufactured for each diameter of BELL MOUTH.

## 15. FACTORY ACCEPTANCE TESTS – FAT

### 15.1. General

15.1.1. The BELL MOUTHS shall be tested individually to verify their mechanical functioning (simulation of the PULL-IN, operation of the latch bars handling mechanisms and PULL-OUT).


15.1.2. The tests shall be performed with the Dummy Cap manufactured in accordance with drawings supplied by Petrobras as listed in item 5.3.

15.1.3. All tests are Supplier's responsibility.

15.1.4. A member of Quality Control department of the Supplier shall witness all tests and is responsible for registering the tests results and filling out the TRS. This member is also responsible for report any deviation occurred during the tests.

15.1.5. A Contractor representative shall witness all tests. This representative will be responsible for approving or rejecting the BELL MOUTH FAT.



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- 15.1.6. Petrobras reserves the right to send a representative to monitor the tests. This representative will not have the responsibility of approving or rejecting the tests.
- 15.1.6.1. For BELL MOUTHS manufactured in Brazil, the Contractor shall notify Petrobras, at least 10 (ten) calendar days in advance or as defined in the terms of the contract, the date when the BELL MOUTH will be available for FAT.
- 15.1.6.2. For BELL MOUTHS manufactured abroad, the Contractor shall inform Petrobras, at least 30 (thirty) calendar days in advance or as defined in the terms of the contract, the date when the equipment will be available to be tested.
- 15.1.7. During all testing, the BELL MOUTHS shall be transported on pallets and is not acceptable transport the BELL MOUTHS in direct contact with the fork of the forklift.
- 15.1.8. Tests performed with the BELL MOUTH inverted (cone facing up) are unacceptable.
- 15.1.9. A load cell shall be installed between the lifting cable and the dummy cap in order to measure the load required to overcome the force exerted by the springs. This measurement shall be reported in the TRS and sent to Petrobras for information.

## 15.2. FAT Procedure

- 15.2.1. Supplier shall submit a FAT Procedure for Contractor analysis and approval.
- 15.2.2. This procedure shall observe at least the requirements in ANNEX A.

## 15.3. FAT Infrastructure

- 15.3.1. Supplier shall provide the entire infrastructure necessary to perform the tests.
- 15.3.2. The infrastructure necessary to perform the test shall contain, at least, the following items:
- 15.3.2.1. One Dummy Cap for each set of BELL MOUTHS of same diameter that will be tested. The Dummy Cap diameter must be compatible with the BELL MOUTH that will be tested;
- 15.3.2.2. One four leg wire hope sling with a rated capacity of 10 tons;
- 15.3.2.3. Four shackles of 1" nominal size for 10 tons of working load limit;
- 15.3.2.4. Load cell to measure the force needed to overcome the springs;
- 15.3.2.5. Four synthetic cables (rope) 10m long for guiding the dummy cap.
- 15.3.2.6. A lifting device, that can be a crane, an overhead crane, etc., capable of suspending the dummy cap with a speed between 2 and 4 m/min;



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15.3.2.7. A test stand containing a fastening device specifically designed to secure the BELL MOUTH so the cylindrical body is plumb. The lower conical part of the BELL MOUTH shall be at an appropriate distance from the floor so the dummy cap can be positioned below it and the handling mechanisms of the latch bars can be operated manually.

15.3.2.8. A walkway and a guardrail shall be available for secure access to the mechanism of the latch bars.

#### 15.4. FAT Results

15.4.1. The FAT results shall be reported in the Test Report Sheet – TRS. A TRS model and instructions on how to fill it out is provided in ANNEX B.

15.4.2. The Supplier’s Quality Control member and the Contractor representative shall issue one report by BELL MOUTH set tested stating one of two results: Accepted or Rejected.

15.4.3. The BELL MOUTH with status “Send to Repair” shall be repaired and retested. It will only be considered “Accepted” after correction of all non-conformities and after passing through all tests.

15.4.4. Any repair made in the BELL MOUTH invalidates all tests performed until that moment.

15.4.5. The BELL MOUTH Rejected shall be discarded and a new BELL MOUTH with the same characteristics shall be manufactured.

15.4.5.1. In this case, the new BELL MOUTH shall receive a new serial number.

15.4.6. The FRTs of rejected and discarded BELL MOUTHS shall be included in the set of data book of approved ones.

15.4.7. In case of any BELL MOUTH performance problems, Petrobras representative is allowed to contact Cenpes in order to assist in the evaluation of non-conformities.

#### 15.5. Sampling Plan for Tests with Load Cell Installed


15.5.1. A sampling plan can be used for tests with the load cell required in item 15.1.9 installed, according to NBR 5426 or ISO 2859.

15.5.2. The sampling plan in Table 1 shall be used for tests with load cell installed.

*Note:* For tests with load cell installed, there is no need of using AQL (or NQA) for definition of acceptance criteria. The measures registered using the load cell are for information only.

Table 1– Sampling plan for tests with load cell installed.

NBR 5426		ISO 2859	
<b>Nível de Inspeção</b>	II	<b>Inspection Level</b>	II
<b>Regime de Inspeção</b>	Normal	<b>Inspection Type</b>	Normal
<b>Plano de Amostragem</b>	Simple	<b>Sampling Plan</b>	Simple

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## 16. MODIFICATIONS AND ADJUSTMENTS

- 16.1.1. The Supplier shall not machine the latch bars to force the contact with the Dummy Cap. The shape and angles of the latch bars shall not be changed from the dimensions and tolerances shown in the manufacturing drawings approved by the Contractor.
- 16.1.2. The Supplier can implement small changes in the BELL MOUTH's design to make it appropriate to their manufacturing process or to correct small non-conformities. In this case, the Supplier shall submit a written document to Contractor describing the problem and the proposed solutions. Contractor shall inform Petrobras about these changes.
- 16.1.3. The changes or corrections mentioned in 16.1.2 will only be implemented after Contractor approval.
- 16.1.4. The document approved shall be included in the data book.

## 17. STRUCTURAL CALCULATION

### 17.1. General

- 17.1.1. Each structural part must be fatigue calculated considering its specific load condition.

### 17.2. Structural calculation

- 17.2.1. The implementation of structural calculations is a Contractor responsibility.
- 17.2.2. If the calculations indicate small structural changes, the drawings shall be reviewed and the revision index shall be updated.
- 17.2.2.1. Petrobras shall be informed about all changes.


## 18. DATA BOOK

### 18.1. General

- 18.1.1. For BELL MOUTHS manufactured in Brazil, the Data Book shall be emitted in Portuguese language, unless otherwise requested. For BELL MOUTHS manufactured abroad, the Data Book must be emitted in the language defined by the contract.

### 18.2. Minimum Content

- 18.2.1. The Supplier shall issue a Data Book of the products, in order to allow traceability of all parts, containing at least the following items:
- 18.2.1.1. Certificate of conformity with time of guarantee according to RM (including elements of fixation);
- 18.2.1.2. Certificate of raw materials and tests according to this specification and project standards;

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- 18.2.1.3. Records of heat treatment and tests according to this specification and project standards;
- 18.2.1.4. Records of Non-Destructive Examinations according to this specification and project standards;
- 18.2.1.5. Records of FAT according to this specification and project standards;
- 18.2.1.6. Qualifications of the welding process and welders according to this specification and project standards;
- 18.2.1.7. Records of dimensional inspection according to this specification and project standards;
- 18.2.1.8. Inspection and Tests Plan (ITP) approved by Costumer;
- 18.2.1.9. Identification and inclusion of all reports issued by Contractor inspection, concerning the released products;
- 18.2.1.10. Identification and inclusion of critical non-conformities of the Supplier / sub supplier and the corrective actions taken concerning the released products;
- 18.2.1.11. Drawings of set containing traceability of all critical components of the project, reported in the ITP.

### 18.3. Distribution

- 18.3.1. The Supplier shall deliver hard copies along with a copy in electronic media of the Data Book to Contractor.

## ANNEX A

### Factory Acceptance Test Procedure Minimum Requirements, Sequence and Acceptance Criteria.

#### 1. Introduction

In the procedure elaborated by the Supplier, the tests description shall contain at least the following information.

**General** - Description of what will be evaluated with the tests.

**Test with the Dummy Cap plumb** – Description of test objective, the test sequence and acceptance criteria.

**Test with the Dummy Cap out of plumb** – Description of test objective, the test sequence and acceptance criteria.

#### 2. General

The tests described below are meant to evaluate if the latch bars and the locking mechanisms are working properly.

Every BSDL shall be tested.

The tests shall be performed using a template called Dummy Cap, Figure 1, plumb lifted.

For the Dummy Cap tests and the latch bars mechanism tests, the inner parts of the BSDL as well as the set of locking mechanisms shall be fully painted, including the anti-fouling layer.

The BSDL shall be securely fastened to the test stand structure, preventing its movement in the longitudinal and transversal directions and neither rotation relative to its main axis.

**IMPORTANT:** As defined in section 15.4.3 of I-ET-3010.00-1300-279-PPC-203 if deviations occur that lead to some repair in BELL MOUTH, the tests shall be restarted from the beginning (**Ra1** test). Repairs invalidate the tests performed previously.

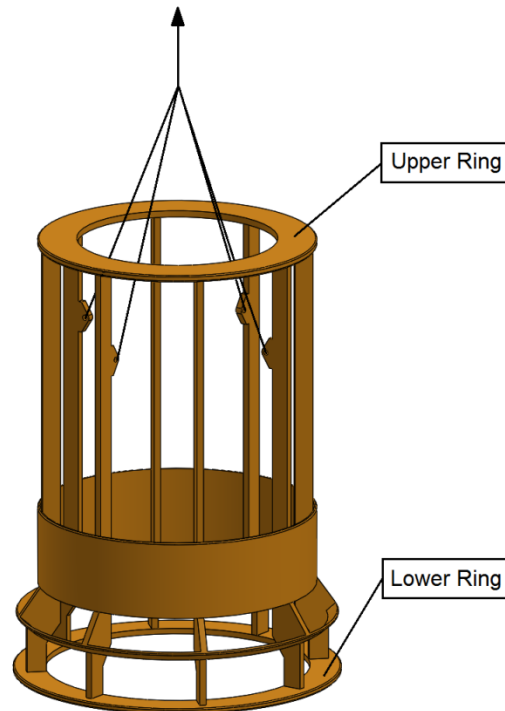


Figure 1 – Dummy Cap – Template for the BSDL tests.

### 3. BSDL internal diameters verification

#### 3.1. Objective

This verification aims to evaluate the BSDL internal diameters, through a drift pipe testing.

The Dummy Cap upper and lower rings diameters are slightly bigger than the Cap DL ones, and are used as templates, as shown in Figure 1.

The upper ring verifies the BSDL internal main interface surface compatibility with the Cap DL that will be furnished by the riser supplier.

The lower ring verifies the concentricity of the BSDL larger internal diameter with its main internal surface. This verification guarantees the correct position of the Round Blocks, and so of the Latch Bars, on the BSDL Main Structure.

The verification described above shall be made during the test with the Dummy Cap. If during any test, described below, the upper and/or the lower rings don't fit in the BSDL, this one is reprocessed.

### 4. Latch bars mechanism alignment

#### 4.1. Objective

This test aims to verify the latch bars mechanism alignment with the BSDL inner surface.

#### 4.2. Procedure

- a. Insert the clips in the round blocks, with the handles on the “lower” position and the latch bars on the “retracted” positions, Figure 2(a) and Figure 3(a).
- b. Actuate 3 (three) times each handle, from “lower” to “upper” position, Figure 2. **(Acceptance Criteria Ra1, item 4.3.1).**
- c. Return the handle to the “lower” position and extract the clip. Check if all latch bars are on the “retracted” positions. **(Acceptance Criteria Ra2, item 4.3.2).**
- d. Actuate 3 (three) times each latch bar from “retracted” to “extended” position, Figure 3, using its respective handle. **(Acceptance Criteria Ra3, item 4.3.3).**

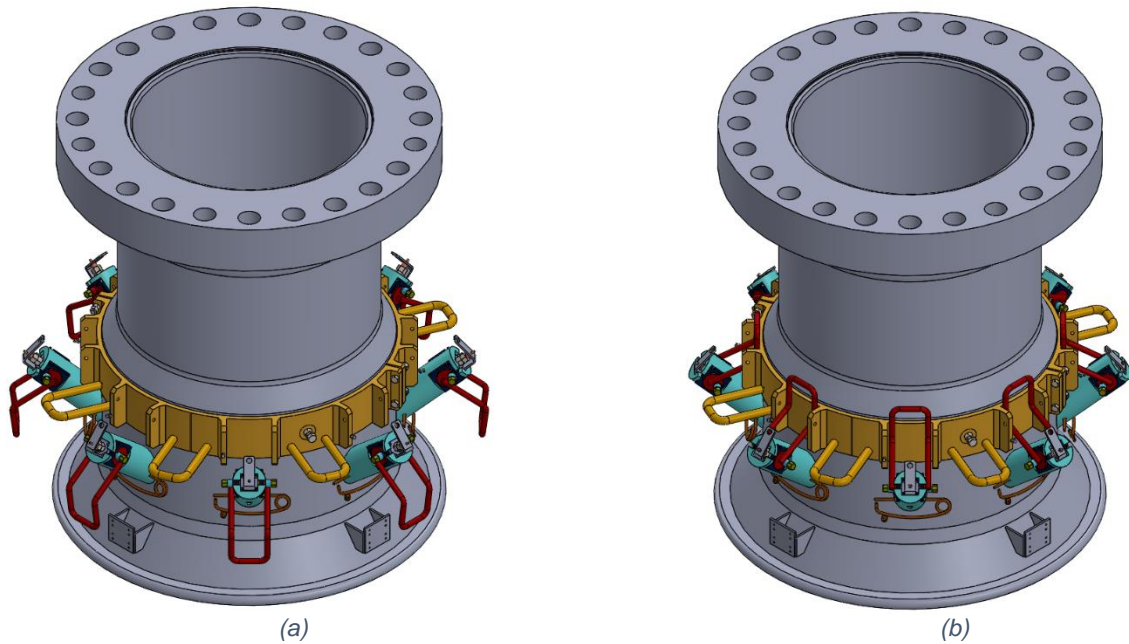


Figure 2 – Handles: (a) Lower position and (b) Upper position.

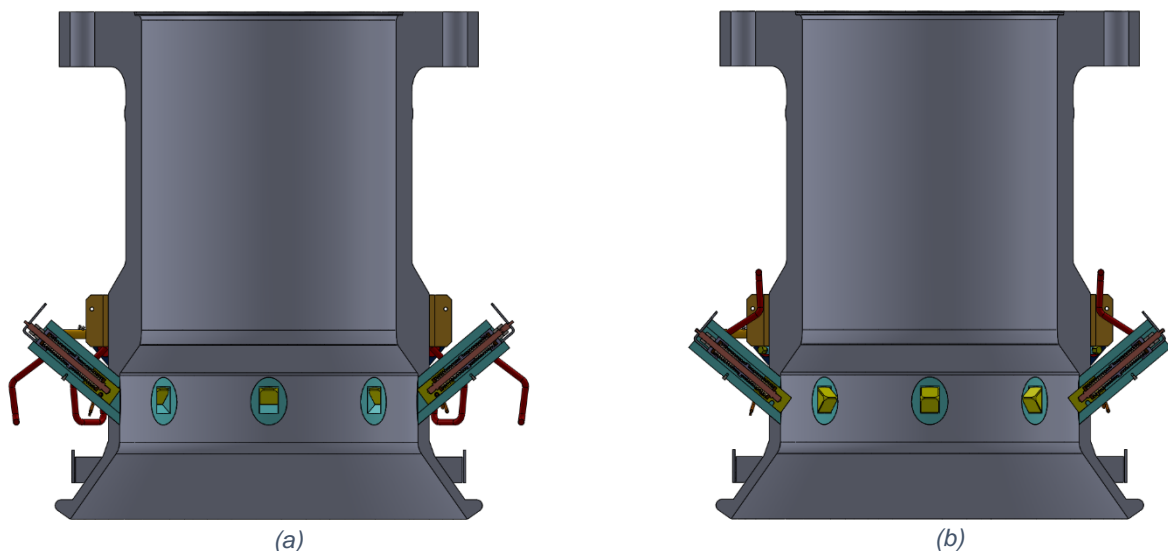


Figure 3 – Latch bars: (a) Retracted and (b) Extended.

## 4.3. Acceptance Criteria

### 4.3.1. Ra1

- i. Handles performance: the only expected effort to do this movement is the one necessary to overcome the spring elastic strength. The reference strength necessary to actuate each handle is 3 Kgf (three kilograms force). If the operator is able to smoothly and softly move each handle, then this step is approved and one shall proceed to the next step. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

#### 4.3.2. Ra2

- i. All latch bars shall be “retracted”, Figure 3(a), and upper aligned with the BSDL inner surface, Figure 4. If the gaps, presented between each latch bar and the BSDL inner surface, are less than or equal to 3mm (three millimeters), then this step is approved and one shall proceed to the next step. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

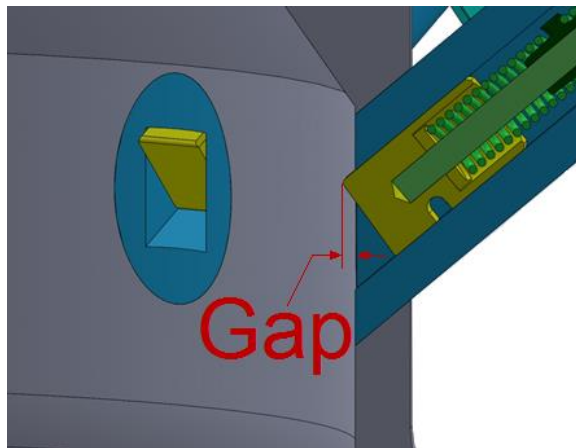


Figure 4 – Upper alignment, between latch bar and BSDL inner surface.

#### 4.3.3. Ra3

- i. Visual inspection: Observe if the latch bars freely move between the “retracted” and “extended” positions. If they do, then this step is approved and one shall proceed to **Ra3.ii** criteria. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.
- ii. Handle and latch bar set performance: the only expected effort to do this movement is the one necessary to overcome the handle and latch bar set inertia. If the operator is able to smoothly and softly move each latch bar from the “retracted” position to the “extended” one, using only the respective handle, then this step is approved and one shall proceed to the next step. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

## 5. Test with the Dummy Cap

### 5.1. Objective

This test aims to verify the latch bars mechanism performance and alignment. This is done by observing the automatic and simultaneous expansion of the latch bars, after the passage of the Dummy Cap through the BSDL.



## 5.2. Procedure

- Preparation
  - e. Place the BSDL with its cylindrical body plumb in relation to the lifting device;
  - f. Place the Dummy Cap below the BSDL and aligned axially with it and with the lifting device cable, with the four-legged sling passing inside the cylindrical body of the BSDL.
  - g. Attach the four-legged sling in the four upper eyebolts of the Dummy Cap symmetrically spaced and using the specified shackles.
  - h. Check if all latch bars are “extended” and the handles are on the “upper” position, locked with the respective clips, Figure 3(b).
- Pull-in Test
  - i. Pull the Dummy Cap into the BSDL at a speed of 4 m/min (four meters per minute);
  - j. Observe the insertion of the dummy cap on BSDL and the latch bars simultaneous and automatic locking (**Acceptance Criteria Ra4, item 5.3.1**).
  - k. Record the load cell measured in Report field.
  - l. If the latch bars have been simultaneously and automatically expanded, spool out the lifting device cable so that the Dummy Cap is freely seated on the latch bars. Check how the Dummy Cap is seated on the latch bars, the expansion of the latch bars and the clearance between them and the Dummy Cap (**Acceptance criteria Ra5, item 5.3.2**).

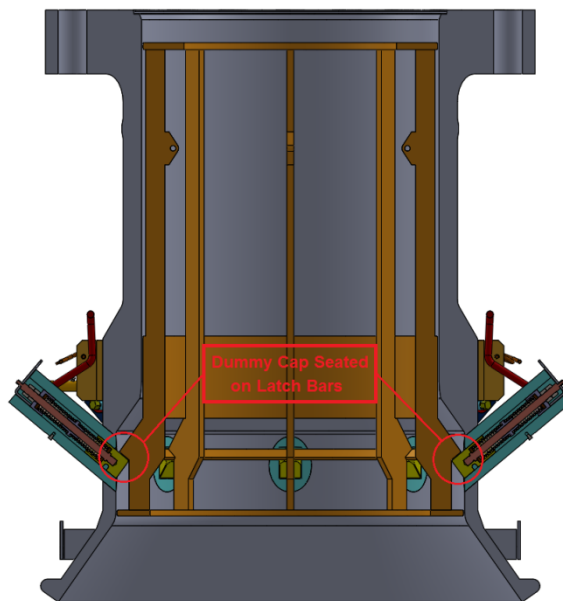


Figure 5 – Dummy cap seated on the latch bars.

- Pull-out Test
  - m. Spool in the lifting device cable until the Dummy Cap is no longer seated on the latch bars.
  - n. Individually actuate each handle to move the latch bars to the “retracted” position, Figure 3(a), allowing the removal of the Dummy Cap. (**Acceptance Criteria Ra6, item 5.3.3**).
  - o. Lower the Dummy Cap until it rests on the floor. (**Acceptance Criteria Ra7, item 5.3.4**).
  - p. Individually actuate each handle to move the latch bars to the “extended” position, Figure 3(b). (**Acceptance Criteria Ra8, item 5.3.5**).

- Test ended.

### 5.3. Acceptance Criteria

#### 5.3.1. Ra4

- The latch bars shall automatically and simultaneously expand after the passage of the Dummy Cap. The verification shall be made through the thud of the latch bars expanding. The thud of the latch bars locking shall be a single and “dry” sound, in unison. If this condition is met, then this step is approved and one shall proceed to the next step. Register in the TRS.
- Delays / advances sonorously perceived indicate that some latch bar is locking later / earlier than expected. If the sound is not single and “dry”, nor in unison, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.
- If any latch bar does not expand, then the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

#### 5.3.2. Ra5

- The Dummy Cap is seated on all latch bars and all of them are evenly expanded or gaps presented between Dummy Cap and the latch bars are less than or equal to 2mm (two millimeters), Figure 5. This step is approved and one shall proceed to the next step. Register in the TRS.
- The Dummy Cap is seated in the following sequence: "One yes one no". Check if the gap between the Dummy Cap and 2 (two) or more latch bars (not properly seated) is greater than 2mm (two millimeters). If so, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests. If not, this step is approved. Register in the TRS.
- The Dummy Cap is not seated on two adjacent latch bars. Check if the gap between the Dummy Cap and 1 (one) of the latch bars is greater than 2mm. If so, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests. If not, this step is approved. Register in the TRS.
- In the event of a combination of ii and iii deviations above mentioned, the test shall be decommissioned and the BSDL shall be sent to repair, regardless the gap between the Dummy Cap and the latch bars. Register in the TRS. Then the tests must be restarted.

#### 5.3.3. Ra6

- Visual inspection: Observe if the latch bars freely move from the “extended” to the “retracted” positions. If they do, then this step is approved and one shall proceed to **Ra6**.ii criteria. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.
- Handle and latch bar set performance: the only expected effort to do this movement is the one necessary to overcome the handle and latch bar set inertia.

If the operator is able to smoothly and softly move each latch bar from the “extended” position to the “retracted” one, using only the respective handle, then this step is approved and one shall proceed to the next step. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

#### 5.3.4. Ra7

- i. The Dummy Cap shall descend freely through the BSDL and then rest on the floor. If the Dummy Cap descends freely, the step is approved. Register in the TRS. Otherwise, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

#### 5.3.5. Ra8

- i. All latch bars shall be “extended”, Figure 3(b), and lower aligned with the BSDL inner surface, Figure 6. If the gaps, presented between each latch bar and the BSDL inner surface, are less than or equal to 5mm (five millimeters), then this step is approved and one shall proceed to the next step. Register in the TRS. Otherwise, if the Latch Bar is on a cantilever position, Figure 7, the deviation shall be evaluated, the test shall be decommissioned and the BSDL shall be sent to repair. Register in the TRS. Then restart the tests.

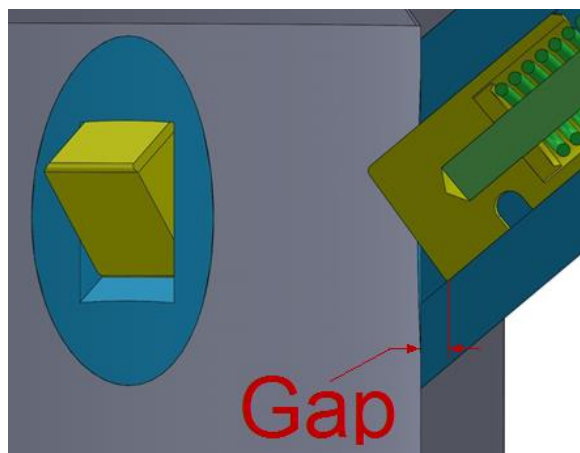


Figure 6 – Lower alignment, between latch bar and BSDL inner surface.

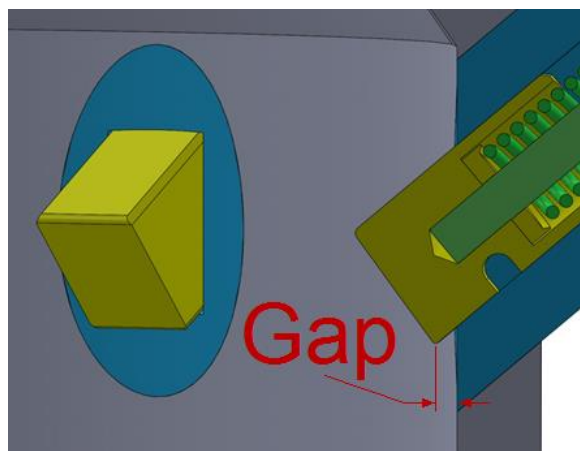


Figure 7 – Latch bar on cantilever position.

## ANNEX B

### 1. TEST RECORD SHEET – TRS

#### 1.1. General

The FAT procedure shall include a document to record the results of each step of the tests, named Test Record Sheet – TRS.

The TRS shall have a format according to the template in section 2 of this annex and present at least the contents listed in the section 1.2 below.

All sheets of all tests shall be filled out using pen.

**IMPORTANT:** As defined in section 15.4.6 of I-ET-3010.00-1300-279-PPC-301, the TRS of BSDLS rejected and sent for scrapping shall be stored along with the data books set of approved BSDLS.

#### 1.2. Minimum Content

The Supplier can add any information considered necessary in the TRS, by inserting a new page at the end of the table.

The following fields shall be part of TRS.

##### 1.2.1. Date

Date of the test.

##### 1.2.2. Supplier

Manufacturer of the BSDL.

##### 1.2.3. Sheet

Indication of page number and total number of pages (ex.: 1/3, sheet 1 of 3, etc.).

##### 1.2.4. Rep. Num.

Report number defined according to supplier's methodology.

##### 1.2.5. ND

BSDL nominal diameter.

##### 1.2.6. SN

BSDL serial number.

##### 1.2.7. SPU

Production unit (FPSO or Semi-submersible) where the BSDL will be installed.

##### 1.2.8. Report

Field to be filled in with any information regarding the current test step.

##### 1.2.9. AP/SR/RE

Indication of Approved, Send to Repair and Reproved (see1.3).

##### 1.2.10. Ra1 to Ra3

Latch bars alignment and locking test.

#### 1.2.11. Rb4 to Rb8

Tests with the Dummy Cap.

#### 1.2.12. Responsible

Name and signature of the responsible for releasing the BSDL.

#### 1.2.13. Result

Result of the tests, Approved or Rejected.

### 1.3. Fields AP, SR and RE

The AP, SR and RE fields shall be marked with an "X" or checked "√", in accordance with one of the three situations shown below.

#### 1.3.1. AP – Approved

The BSDL is released to the next test. This option will be marked alone if the test passes with no indication of repairs.

#### 1.3.2. SR – Send to Repair

There was a deviation during the test and the BSDL must be repaired and retested.

The deviation occurred shall be reported, as well as the description of what shall be done to repair the BSDL. After repairing, the BSDL shall be submitted to test again from the very beginning (Ra1 test).

In case of repairing the BSDL, besides the SR field, the AP or RE field may be marked after the second test, depending on the result of this test. That is, if both AP and SR fields are marked, it means that the BSDL was tested and failed; it was sent to repair, tested again and later approved. Similarly, if SR and RE are marked, it means that the BSDL was tested and failed, it was sent to repair, tested again and failed again, indicating that it shall be discarded.

#### 1.3.3. RE – Reproved

The BSDL shall be discarded. This option will be marked alone if the rejection indicates discard without repairs.

**IMPORTANT:** As defined in section 15.4.5.1 of I-ET-3010.00-1300-279-PPC-301, the new BSDL, manufactured to replace the rejected one, shall receive a new serial number.

## 2. Test Record Sheet – TRS Template

LOGO	<b>BSDL TEST RECORD SHEET</b>
------	-------------------------------

Sheet:	Supplier:	Rep. Num.:
--------	-----------	------------

BSDL information:

ND	SN	SPU

Subtitle:

AP - Approved.

SR - Send to Repair

RE - Reproved.

### 1. LATCH BARS ALIGNMENT.

crit.	step	report	AP	SR	RE
Ra1	Handles operation & spring test.				
Ra2	Latch bars "retracted".				
Ra3	Handles & latch bars sets operation.				

### 2. LATCH BARS LOCKING PERFORMANCE AND ALIGNEMENT.

crit.	step	report	AP	SR	RE
Ra4	Latch bars locking operation				
Ra5	Dummy Cap seating.				
Ra6	Handles & latch bars sets operation.				
Ra7	Dummy Cap lowering.				
Ra8	Handles & latch bars sets operation.				

LOGO	<b>BSDL TEST RECORD SHEET</b>
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Sheet:	Supplier:	Rep. Num.:
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BSDL information:

ND	SN	SPU

Subtitle:  
 AP - Approved.  
 SR - Send to Repair  
 RE - Reproved.

2. **Observations**

3. **Result**

ACCEPTED <input type="checkbox"/> <span style="margin-left: 200px;">REJECTED <input type="checkbox"/></span>	
Date:	Responsible (Signature and stamp):