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	CLIENT: PETROBRAS E&P		SHEET: 1 of 17
	JOB:		-
	AREA: SUBSEA INSTALLATIONS		NO SCALE / A4
SUB/ES	TITLE: TEST REQUIREMENTS FOR SUBSEA CONNECTOR SYSTEMS FOR DIVERLESS RIGID SPOOL		NP-1
			EECE/EES


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INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
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A	Revised in order to verify accordance to the Brazilian law 13.303
B	General revision


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1. INTRODUCTION

1.1. OBJECTIVE

- 1.1.1. The purpose of this Technical Specification is to complement, confirm and clarify specific requirements stated in API RP 17R, IOGP S-561, ISO 13628-15 and ISO 13628-4 regarding the design validation and factory tests for subsea connector systems for diverless rigid spool. It aims also to standardize the understandings between Petrobras and Suppliers.
- 1.1.2. It is not expected or desired that the requirements contained herein drive re-validation but shall be used for gap assessment of existing products validated as per API 17D second edition and for validation testing of new designs.

1.2. SCOPE

- 1.2.1. The scope of this document is the same defined in I-ET-3000.00-1500-24A-PEK-001.

2. TERMS AND DEFINITIONS


2.1. VERBAL TENSES

- 2.1.1. Following verbal forms are used throughout this document:

Shall	Mandatory requirement
Should	Preferred requirement
May	A permissible course of action
Must not	Prohibited requirement

2.2. DEFINITIONS

- 2.2.1. All terms defined in I-ET-3000.00-1500-24A-PEK-001 are applicable, in addition to the following:
- 2.2.2. **Performance Verification Test (PVT)**
Tests intended to demonstrate and qualify performance of generic product families, as being representative of defined product variants. PVT is also referred as design qualification or validation.
- 2.2.3. **Factory Acceptance Test (FAT)**
Tests intended to demonstrate the operating capability of a specific as-shipped item.
- 2.2.4. **System Integration Test (SIT)**
Group of tests used to check the interfaces and to demonstrate tolerance requirements and correct functioning of the complete system.

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2.3. ABBREVIATIONS

ET	Technical Specification
FAT	Factory Acceptance Test
IVB	Independent Verification Body
MCV	Vertical Connection Module
NDT	Non-Destructive Technique
PVT	Performance Verification Test
RM	Material Request
RWP	Rated Working Pressure
SIT	System Integration Test

3. REFERENCES


The latest edition of the codes and specs below shall be adopted, unless otherwise stated.

3.1. TECHNICAL DOCUMENTS

Ref.	Designation	Rev.	Title
1	I-ET-3000.00-1500-24A-PEK-001		Subsea Connector Systems for Diverless Rigid Spool

3.2. CODES AND STANDARDS

Ref.	Designation	Title	Ed.	Year
2	ISO 13628-4	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 4: Subsea wellhead and tree equipment		
3	ISO 13628-15	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 15: Subsea structures and manifolds		
4	API RP 17R	Recommended Practice for Flowline Connectors and Jumpers		
5	IOGP S-561	Supplementary requirements to API SPEC 17D Subsea Trees		
6	ISO 10423	Petroleum and natural gas industries – Drilling and production equipment – Wellhead and christmas tree equipment		

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4. GENERAL

4.1. PHILOSOPHY

- 4.1.1. A product shall have its functional requirements confirmed by the manufacturer through testing. More specifically, the following tests shall be performed:
- Validation tests, which are intended to demonstrate and qualify the performance of generic product families, proving that they meet all design assumptions specified in RM, including service conditions, in accordance with the procedures specified by Manufacturer and Purchaser;
 - Factory tests, which are intended to prove the operating capability of a specific as-shipped item.
- 4.1.2. The prototype may be replaced by a production unit for testing, if appropriate. In this case the dimensions of the production unit shall be registered, not only verified during inspection, and it shall be overhauled after completing the tests.

4.2. REQUIREMENTS

- 4.2.1. ISO 13628-15, ISO 13628-4 and ISO 10423 and the Supplementary Requirements from IOGP S-561 are the base standards for the connector system tests procedures and shall be fulfilled, according to Petrobras requirements stated in this Technical Specification.
- 4.2.2. Pressure containing/controlling devices of the connector system shall comply with PSL informed in the RM, as defined in ISO 10423.
- 4.2.3. Measuring and testing equipment used to assist on the test shall be in accordance with ISO 10423 item 7.2.
- 4.2.4. Personnel performing measurements, inspections or tests shall be qualified according to the requirements stated in ISO 10423 item 7.3.
- 4.2.5. As stated in ISO 10423 item F.1.4.4, the product used in any pressure test during PVT shall be free of paint or other coatings that can impede leak detection and/or leak observation. The equipment may be painted before FAT as per ISO 13628-4 item 5.4.5.1, however thermal insulation coatings shall be applied after the hydrostatic tests.
- 4.2.6. All equipment involved in the test shall be clean, with all parts and sealing areas inspected and photographed to check for possible damage.
- 4.2.7. Supplier shall issue the test documentation as per ISO 10423 item F.1.15. Detailed drawings do not need to be part of the test documentation as long as it presents all information that ensures the traceability of qualified items, so that all the products supplied have had its design validated.
- 4.2.8. All ring gaskets used in PVT, FAT and SIT must not be reused as product unit.
- 4.2.9. As per ISO 13628-4, item 5.1.7.1, these are minimum requirements based on ISO 13628-4. The manufacturer shall define additional validation tests that are applicable and demonstrate that this validation testing can be correlated with the intended service life and/or operating conditions in accordance with the purchaser requirements.

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5. PERFORMANCE VERIFICATION TEST (PVT)

5.1. GENERAL


- 5.1.1. PVT shall be performed according to ISO 13628-4 item 5.1.7 and item 7.18.4.2, and supplementary requirements from IOGP S-561.
- 5.1.2. Scaling, as defined in ISO 10423 annex F, must not be considered. However, the connector system internal diameter is not considered an essential variable in the qualification. This implies that it may be modified with no need of re-qualification, as long as the PVT has been conducted with a prototype with the largest internal diameter.
- 5.1.3. The supplier shall send the design qualification procedures for Petrobras evaluation and approval.
- 5.1.4. In case of qualification already performed for other applications/scenarios, the manufacturer shall issue the qualification report (dossier) for Petrobras evaluation and approval. If the qualification was performed for another client and copyrights policy was agreed, Petrobras does not expect to receive all the detailed actions occurred during the tests, but only the procedure used for the tests and the statement of compliance signed by an IVB. All PVT report (dossier) performed for Petrobras cannot be issued to other clients. The tests reports shall be presented stamped and signed by Third Parties (IVB – Independent Verification Body).
- 5.1.5. In case the presented qualification report covers a part of the tests required by this specification and applicable references, but not all, a Qualification Gap Analysis shall be issued for Petrobras evaluation. Based on this report, the required tests to complement the qualification will be detailed.
- 5.1.6. As stated in ISO 10423 item F.1.6.5, after completing all tests, the prototype shall be disassembled, dimensionally and visually inspected and photographed.
- 5.1.7. If the supplier decides to use the prototype as a product unit, the post-test examination shall include a visual inspection and NDT; it is also required to replace all elastomeric seals and any other damaged and/or worn component. All examination shall include a written statement that neither the product nor component design contains defects to the extent that any performance requirement is not met.

5.2. CONNECTOR SYSTEM

- 5.2.1. Validation requirements prescribed in ISO 13628-4 item 7.18.4.2 shall be demonstrated by Supplier, by presenting evidences that these tests were successfully conducted.
- 5.2.2. Qualification requirements for MCVs are beyond the scope of this Technical Specification.

5.3. SUBSEA CONNECTOR

- 5.3.1. The tests presented in **Erro! Fonte de referência não encontrada.** shall be performed for the subsea connector performance verification test, which are based on requirements of ISO 13628-4 and ISO 10423. The exact order of the qualification steps specified for the connector PVT may be altered upon Petrobras approval.

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Qualification step	Mandatory	Test name	Standard requirements		Additional remarks
			Standard code	Reference	
Functional test	Yes	Functional test	ISO 13628-4	7.18.4.2	See 5.3.2
Hydraulic system test	Recommended	Hydraulic system hydrostatic test	ISO 13628-4	5.4.7	See 5.3.3
Electric continuity test	Recommended	Electric continuity test	ISO 13628-4	5.4.8	See 5.3.4
Pressure cycling test	Yes	Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5
		Pressure cycling test	ISO 13628-4	5.1.7.4	See 5.3.6
		Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5
		Gas body test*	ISO 10423	7.4.9.5.7	See 5.3.7
Load test	Yes	Load test	ISO 13628-4	5.1.7.5	See 5.3.9
Endurance test	Yes	Endurance test	ISO 13628-4	5.1.7.7	See 5.3.10
		Gas body test*	ISO 10423	7.4.9.5.7	See 5.3.10

5.3.2. Functional Test

5.3.2.1. As a minimum, the following shall be verified:

- If all locking mechanisms are operational;
- If all unlocking mechanisms are operational;
- If all ring gasket holding mechanisms are operational;
- If visual indicators are operational.

5.3.2.2. The acceptance criteria for these tests are:

- The equipment is required to function in a smooth way, reaching its maximum and minimum strokes, without losing any of its functionalities;
- The values for pressure, torque, displacements, etc. shall be within the project limits.

5.3.3. Hydraulic System Pressure Test

5.3.3.1. As stated in ISO 13628-4 item 5.4.7, the pressure used for this test shall be 1.5 times the hydraulic RWP.


5.3.3.2. As stated in ISO 10423 item 7.4.9.5.4, the primary holding period shall be, as a minimum, 3 min and the secondary hold period a minimum of 15 min.

5.3.3.3. Hydraulic lines, soft landing and any other components that contain hydraulic control fluid shall be tested.

5.3.3.4. According to ISO 13628-4 item 5.4.7, the test medium shall be the hydraulic system fluid.

5.3.3.5. The acceptance criteria for this test are:

- As per ISO 13628-4 item 5.4.7, no visible leakage;
- As per ISO 13628-4 item 5.4.7, chart recording is not required.

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5.3.4. Electric Continuity Test

5.3.4.1. As per ISO 13628-4, item 5.4.8. The measuring points shall be informed by the manufacturer.

5.3.5. Hydrostatic Pressure Test

5.3.5.1. The test shall be carried out as defined in ISO 13628-4 item 5.4.5.1.

5.3.5.2. ISO 10423 item 7.4.9.5.4 defines the primary hold period a minimum of 3 min and the secondary hold period a minimum of 15 min.

5.3.5.3. The test medium shall be (fresh) water with anti-corrosion additives.

5.3.6. Pressure Cycling Test

5.3.6.1. The test shall be carried out as defined in item 5.1.7.4 and table 3 of ISO 13628-4.

5.3.6.2. If the connector system has a PSL 3G, a gas body test shall be performed after the hydrostatic test for the purpose of acceptance of the pressure cycling test. For other PSL requirements, the hydrostatic test performed after the pressure cycling test shall be considered for the acceptance of the pressure cycling test.

5.3.7. Gas Body Test

5.3.7.1. Before each gas body test, a hydrotest according to 5.3.5 shall have been previously performed.

5.3.7.2. The test shall be carried out as defined in item 7.4.9.5.7 of ISO 10423.

5.3.7.3. The gas body test shall be performed in the body of the connector (test from inside to outside), not in the annular.


5.3.7.4. The leak detection method shall be in accordance with ISO 10423 item F.1.8. Gas testing at room temperature shall be conducted with a method for leak detection. In the described case where one end of a tube is connected to a blind connector enclosing all possible leak paths being validated and the other is immersed in a liquid or attached to a leakage measurement device, the apparatus shall be able to fill the tube with the testing gas, prior to starting the test. Other methods able to detect leakage accurately may be proposed for Petrobras approval.

5.3.8. Back Seal Test

5.3.8.1. The pressure for this test shall be 1.1 times the hydrostatic pressure relative to the project water depth.

5.3.8.2. The back seal test shall be performed in the annulus of the connector (test from outside to inside).

5.3.8.3. All other requirements presented in 5.3.5 are applicable with the exception of hold period that shall be not less than 15 min and pressure value defined above.

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5.3.9. Load Test

5.3.9.1. For the achievement of this test, all the steps listed in Table 1 are mandatory and shall be performed. The order for the accomplishment of these steps may be different.

Table 1: Load cases for the connector PVT

Test number	Test name
1	Torsion
2	Torsion + pressure
3	Moment
4	Moment + pressure
5	Torsion + moment
6	Torsion + moment + pressure

- 5.3.9.2. The loads imposed in the system shall be defined by the manufacturer together with the EPCI contractor. In order to qualify the design for future projects, it is recommended that the loads applied shall be as high as possible, without losing any functionality, including sealing.
- 5.3.9.3. As defined in ISO 13628-4 item 5.1.7.3, gas shall be used as test medium for pressure hold periods. Due to safety reasons liquid may be used as test medium. However in case liquid is used, a gas body test (5.3.7) shall be performed after all sequence of load tests for the purpose of acceptance of the load test.
- 5.3.9.4. The load cases in which pressure is not included shall be performed with pressure of 10% RWP being applied on the seal annular, for leakage verification proposes only. If these tests are not performed the load capacity at zero pressure will be considered equal to load capacity at RWP.
- 5.3.9.5. The load cases in which pressure is included shall be performed considering a body pressure of RWP.
- 5.3.9.6. For each load case, the following sequence shall be followed:
- Apply pressure in the body;
 - Perform 3 load cycles (cycle from zero to the specified load);
 - Keep pressure and load during the holding period (15 min).
- 5.3.9.7. Instead of maintaining pressure during all three loads cycles, it may be applied (and drained after the hold period) within each of those cycles.
- 5.3.9.8. The acceptance criteria for these tests are:
- According to ISO 13628-4 item 5.1.7.5, no deformation to such an extent that any other performance requirement is affected, which includes maintaining a leak tight connection;
 - Similar as stated in 5.3.7.
- 5.3.9.9. Stresses and strains measurements are recommended but not mandatory for these tests. However, in case of such data are measured by the manufacturer during the qualification of a connector system for Petrobras, access to all results shall be given. The locations of measurements devices are defined by the manufacturer. Petrobras may advise if asked to.

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5.3.10. Endurance Test

- 5.3.10.1. It shall be performed 50 cycles for the endurance test.
- 5.3.10.2. As stated in ISO 13628-4 item 5.1.7.7, secondary functions, such as connector secondary unlock (if applicable), shall be included in this testing, resulting in a total of 100 cycles (50 cycles for the primary unlock and 50 for the secondary unlock; in this case, the secondary unlock cycles may be done without the ring gasket). The contingency unlock system does not need to be verified during the endurance tests.
- 5.3.10.3. After the endurance cycles, a body test to verify leakage shall be performed for the purpose of acceptance of this test. If PSL 3G is specified, a gas body test, as defined in 5.3.7, shall be conducted.

5.3.11. General Requirements

- 5.3.11.1. The requirements presented in this section are regarding all tests presented in section 5.3.
- 5.3.11.2. The connector shall lock and unlock with no need for maintenance of the locking system and sealing areas.
- 5.3.11.3. When primary and secondary independent seal mechanisms are part of the design, both shall be independently verified (ISO 13628-4, item 5.1.7.2). If one or more elastomeric rings are used between the back seal port and the metal x metal seal area, then it shall be intentionally damaged or removed for the accomplishment of these tests. This procedure shall be witnessed.
- 5.3.11.4. For hydraulically operated systems, all the cycles shall be executed with actuation pressure below 90% of the nominal actuation pressure.
- 5.3.11.5. As stated in ISO 13628-4 item 5.1.7.2, the equipment should be qualified with the minimal lubricants required for assembly unless the lubricants can be replenished when the equipment is in service or is provided for service in a sealed chamber. Also, in order not to change the tribological characteristics of surfaces where these are important parameters of the connector design, and were assured only with the application of special grease, this may be applied at minimum amount needed to ensure the tribological characteristics. In this case the grease specification and evidences that demonstrate that it will remain on the surfaces along the connector service life must be provided. Under no circumstances grease may be applied in surfaces that provide sealing and/or pressure containing.
- 5.3.11.6. Gaskets may be replaced if necessary during these tests. In this case, the details of this new gasket and the moment of the replacement shall be recorded.

5.4. RING GASKETS

- 5.4.1. The qualification steps presented in Table 2 are mandatory. They shall be performed for the ring gasket performance verification tests, which are based on ISO 13628-4 and ISO 10423. The exact order for the accomplishment of the qualification steps may be altered upon Petrobras approval.


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Table 2: Qualification steps specified for the ring gasket PVT

Qualification steps	Test name	Standard requirements		Additional remarks
		Standard code	Reference	
Pressure and temperature cycling test	Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5
	Pressure and temperature cycling test	IOGP S-561	P.4.2	See 5.4.2
	Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5
	Gas body test *	ISO 10423	7.4.9.5.7	See 5.3.7
Endurance test	Endurance test	ISO 13628-4	5.1.7.7	See 5.4.3
	Gas body test *	ISO 13628-4	5.4.5.1	See 5.3.7
Hyperbaric test	Hyperbaric test	ISO 13628-4	Annex L	See 5.4.4
	Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5


* Only for PSL 3G

5.4.2. Pressure and Temperature Cycling Test

- 5.4.2.1. The test procedure stated in IOGP S-561 Section P.4.2 shall be followed.
- 5.4.2.2. The requirements for the temperature testing defined in IOGP S-561 Section P.4.2 and ISO 10423 item F.1.9 shall be fulfilled.
- 5.4.2.3. The temperature shall be stabilized as defined in ISO 10423 item F.1.10.c.
- 5.4.2.4. As defined in ISO 13628-4 item 5.1.7.3, gas shall be used as test medium for pressure hold periods.
- 5.4.2.5. As per IOGP S-561, the acceptance criteria for this test are:
 - As per API RP 17D PSL 3G Section 5.4.6.2.3, no visible bubbles during the holding period;
 - As per ISO 10423 item 7.4.9.5.7, a reduction of the gas test pressure not greater than 300 psi, as long as there are no visible bubbles during the hold period.

5.4.3. Endurance Test

- 5.4.3.1. It shall be performed 10 cycles for the endurance test with same ring gasket. Optionally, the 10 cycles test in one single ring may be replaced by a total of 9 cycles using 3 rings, each one being cycled 3 times.
- 5.4.3.2. After each of the 10 cycles (or after each 3x3 cycles) a gas seal test shall be conducted as acceptance for this test. In case PSL 3G was specified to the connector system under qualification, a gas body test as defined in 5.3.7 shall be performed for the purpose of acceptance of the endurance test.
- 5.4.3.3. This test can be performed as part of 5.3.9, provided the requirements specified in item 5.4.5 are fulfilled.
- 5.4.3.4. The acceptance criterion for this test is no bubbles during seal test.

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5.4.4. Hyperbaric Test

- 5.4.4.1. As defined in ISO 13628-4 table L.1, the internal pressure cycles shall be at least 200.
- 5.4.4.2. According to ISO 13628-4 annex L, the component shall be internally pressurized to the RWP, while continuously subjected to the external pressure.
- 5.4.4.3. The internal test medium may be liquid or gas and the external test medium shall be liquid.
- 5.4.4.4. The external pressure shall be 1.1 times the hydrostatic pressure relative to the project water depth.
- 5.4.4.5. The external pressure may be applied to the annulus.
- 5.4.4.6. As stated in ISO 13628-4 annex L, after the functional hyperbaric cycles, a hydrostatic test shall be performed for the purpose of acceptance of the hyperbaric test. For this test, the requirements included in 5.3.5 are applicable.


5.4.5. General Requirements

- 5.4.5.1. When primary and secondary independent seal mechanisms are part of the design, both shall be independently verified (ISO 13628-4, item 5.1.7.2). If one or more elastomeric rings are used with another function between the back seal port and the metal x metal seal area, then it shall be intentionally damaged or removed for the accomplishment of these tests. This procedure shall be witnessed.
- 5.4.5.2. If any gasket needs to be replaced during any qualification step, all steps shall be repeated.
- 5.4.5.3. As stated in ISO 13628-4 item 5.1.7.2, worst conditions for dimensional tolerances shall be addressed by the manufacturer. Therefore, the tests presented in Table 2 shall be performed in the minimum contact stress between the gasket and the sealing areas.
- 5.4.5.4. The procedure suggested by Petrobras to achieve the minimum contact stress condition is:
 - Produce at least three ring gaskets and measure all;
 - Find the ring gasket with the minor dimension at sealing area and use it for the tests.
- 5.4.5.5. In order to demonstrate that the minimum contact stress was achieved the following documents shall be issued:
 - Measurement report of the ring gasket, inboard and outboard hub;
 - Clearance and tolerance study.

6. FACTORY ACCEPTANCE TEST (FAT)

6.1. GENERAL

- 6.1.1. As stated in ISO 13628-4 item 5.4.1, the quality control requirements shall conform to ISO 10423.
- 6.1.2. Serialization and traceability shall comply with the requirements stated in ISO 10423 item 7.4.9.2.

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6.2. TESTS

6.2.1. Tests defined in Table 3 are mandatory. They shall be performed for all equipment during the factory acceptance test, according to the Petrobras considerations. The order for the accomplishment of the test may be altered upon Petrobras approval.

Table 3: Tests specified for the FAT

Test number	Test name	Standard requirements		Additional remarks
		Standard code	Reference	
1	Functional test	ISO 13628-4	7.18.4.3	See 5.3.2
2	Hydraulic system hydrostatic test	ISO 13628-4	5.4.7	See 5.3.3
3	Electric continuity test	ISO 13628-4	5.4.8	See 5.3.4
4	Hydrostatic test	ISO 13628-4	5.4.5.1	See 5.3.5
5	Gas body test	ISO 10423	7.4.9.5.7	See 5.3.7
6	Back seal test	ISO 13628-4	5.4.5.1	See 5.3.8
7	Pad eye load test	ISO 13628-4	5.4.4	See 6.2.2
8	Drift test	ISO 13628-4	5.4.5.2	See 6.2.3
9	Cleaning tool fit-up test	ISO 13628-4	7.18.4.3	See 6.2.4
10	Protection cap test	ISO 13628-4	7.18.4.3	See 6.2.5

6.2.2. Pad Eye Load Test

6.2.2.1. Lifting pad eyes shall be individually proof-load tested to at least two and one-half (2.5) times the documented safe work load for the individual pad eye (SWL/number of pad eyes), as stated in ISO 13628-4 item 5.4.4.

6.2.2.2. According to ISO 13628-4 item 5.4.4, pad eyes shall be tested with magnetic particles and/or dye penetrant following proof testing. The acceptance criterion for this test is:


- No deformation to such an extent that any performance requirement is affected;
- Acceptance criteria according to the NDT adopted.

6.2.3. Drift Test

6.2.3.1. As per ISO 13628-4 item 5.4.5.2, the drift test shall be performed after the completion of pressure testing. The test shall be performed with a drift PIG plate. The acceptance criteria for this test are:

- PIG must not get stuck inside the connector system during the test;
- The PIG must not be damaged in a way to restrict its functionalities after passing through the bore;
- Sealing areas must not be damaged.

6.2.3.2. The PIG shall be photographed before and after the passage.

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6.2.4. Cleaning Tool Fit-up Test

6.2.4.1. The cleaning tool shall be able to fit the inboard hub correctly and the abrasion pads shall have contact with the metal sealing surface. In case other surfaces need to be cleaned, like the surface where o'rings seal for pressure caps, these surfaces shall also be cleaned by the cleaning tool.

6.2.5. Protection Cap Test

6.2.5.1. The protection cap shall be able to fit and lock into the inboard hub.

6.3. REQUIREMENTS

- 6.3.1. When primary and secondary independent seal mechanisms are part of the design, both shall be independently verified (ISO 13628-4, item 5.1.7.2). If one or more elastomeric rings are used with another function between the back seal port and the metal x metal seal area, then it shall be intentionally damaged or removed for the accomplishment of these tests. This procedure shall be witnessed.
- 6.3.2. For hydraulic operated systems, all the cycles shall be executed with actuation pressure below 90% of the nominal actuation pressure.
- 6.3.3. The connector shall lock and unlock with no need for maintenance of the lock system and sealing areas.
- 6.3.4. The blocking cap and the testing cap shall also be tested during hydrostatic test and gas body test.


7. SYSTEM INTEGRATION TEST

- 7.1. This ET defines 4 types of interchangeability requirements. The RM shall define which one shall be considered for each project. If nothing is defined in the RM, the 1x1 interchangeability shall be considered.
- 7.2. Other SIT requirements shall comply with RM.

7.3. NXN INTERCHANGEABILITY

7.3.1. A back seal test shall be performed after connection of each combination of connectors, caps and inboard hubs (Figure 1).

Note: NxN interchangeability requirement will most likely have a schedule and logistic impact and shall be specified only for reduced group of connectors which may be interchanged during field life.

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7.4. 1X1 INTERCHANGEABILITY

7.4.1. A back seal test shall be performed once for each pair of connector and inboard hub (Figure 2).

7.5. 1XN INTERCHANGEABILITY

7.5.1. A back seal test shall be performed considering one connector with all inboard hubs (Figure 3).

7.6. NX1 INTERCHANGEABILITY

7.6.1. A back seal test shall be performed considering one inboard hub with all connectors and caps (Figure 4).

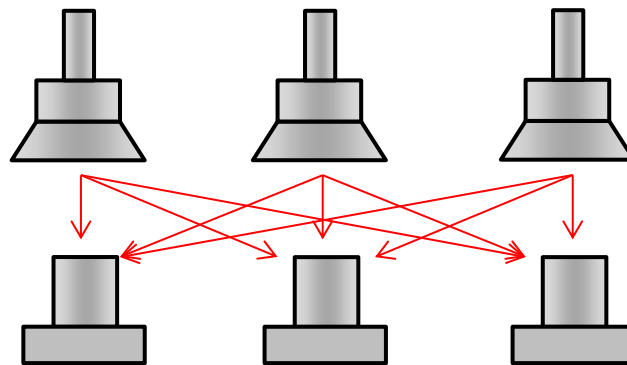


Figure 1: NxN interchangeability

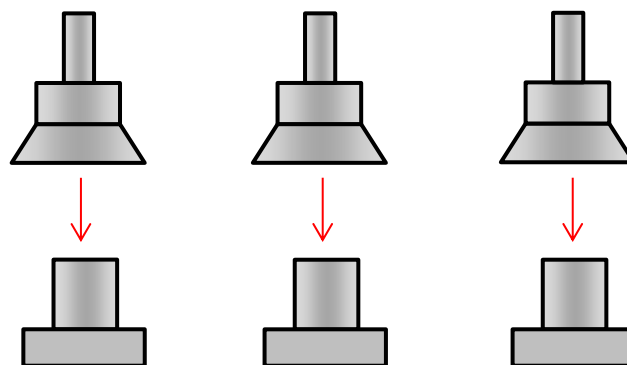



Figure 2: 1x1 interchangeability

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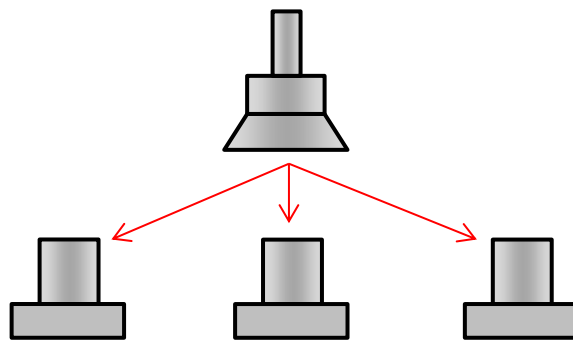


Figure 3: 1xN interchangeability

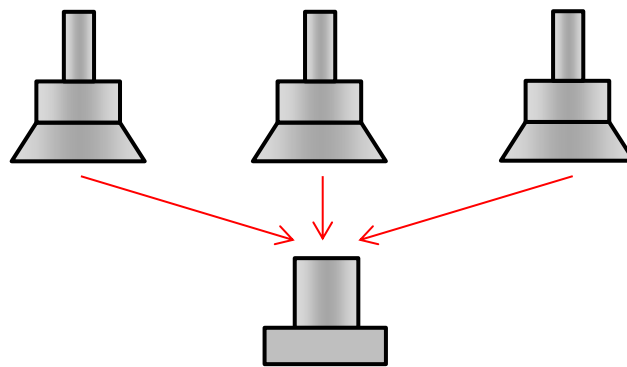



Figure 4: Nx1 interchangeability

8. DOCUMENTATION

- 8.1. The supplier shall provide at least the following documents for Petrobras analysis and analysis:
- Connector System PVT procedures;
 - Connector System PVT report;
 - Connector PVT procedures;
 - Connector PVT report;
 - Ring gasket PVT procedures;
 - Ring gasket PVT report;
 - FAT procedures;
 - FAT report;
 - SIT procedures;
 - SIT report;
 - Qualification Gap Analysis (if applicable)
- 8.2. Procedure documents shall include all the activities that will be performed during all the tests predicted for this specific document.

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- 8.3. Report documents shall include all the results obtained in all the activities included in the procedure document.
- 8.4. All the reports shall be presented, stamped and signed by Third Parties (IVB – Independent Verification Body) recognized by Petrobras.