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1 SUBJECT

This technical specification of requirements (TS-R) presents the minimal technical and functional prerequisites for stage collars with mechanical actuation, for applications in intermediate casings, production casings and liners. Nominal diameters covered vary from 9 7/8" to 13 5/8".

The document also presents the required qualification tests and acceptance criteria for Petrobras scenario.

Refinements required for the construction of each unit of stage collar (e.g.: steel grade, connection thread type) as well as the amount of units to be ordered will be supplied on a later document, called ET-RBS.

2 SUPPLEMENTARY DOCUMENTS

ET-3000.00-1210-130-PPQ-1 – “Componentes Elastoméricos de Poço”

API RP 5C5, “Procedures for Testing Casing and Tubing Connections”, 2017.

API 19 AC – Specification for Completion Accessories;

API 96, Deepwater Well Design and Construction, 2013.

API SPEC Q1 – Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry.

API SPEC 10F - Cementing Float Equipment Testing, 2018

API SPEC 11D1 – Packers and Bridge Plugs

API SPEC 19OH – Openhole Isolation Equipment

ANSI/NACE MR0175/ISO 15156-1:2015 – Petroleum and Natural Gas Industries – Materials for use in H₂S-containing Environments in Oil and Gas Production

ISO-11960 – Steel pipes for use as casing or tubing for wells;

ISO 13679, Petroleum and natural gas industries — Procedures for testing casing and tubing connections, 2002.

ISO 14998, Petroleum and natural gas industries — Downhole equipment — Completion accessories, 2013.

ISO 14310, Petroleum and natural gas industries — Downhole equipment — Packers and bridge plugs, 2008.

ISO 23936-2 - Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 2: Elastomers

API TR 6J1 - Elastomer Life Estimation Testing Procedures; First edition, August 2000

ASTM D741 16a - Standard Test Method for Rubber Property — Effect of Liquids

API 5CT:2011 – Specification for Casing and Tubing.

ISO 10400:2007 – Petroleum and natural gas industries – Equations and calculations for the properties of casing, tubing, drill pipe and line pipe used as casing and tubing.



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3 TERMS AND DEFINITIONS

- ET-R – “Especificação Técnica de Requisitos” – stands for Technical Specification for Requirements (TS-R)
- ET-RBS – “Especificação Técnica de Requisição de Bens e Serviços” – stands for Technical Specification of Supplies and Goods Requisitions. Documentation that details the bidding and is based on a TS-R.
- ECP – External casing packer
- FMEA – Failure Modes and Effects Analysis;
- FMECA – Failure Modes, Effects and Criticality Analysis;
- TTF – Time To Failure
- OD – Outside Diameter
- ID – Inside Diameter
- Maximum absolute pressure – Maximum pressure equipment is expected to experience downhole
- $P_{internal}$ – Minimum resistance to internal pressure required for the collar.
- $P_{external}$ – Minimum resistance to external pressure required for the collar.
- $P_{open, Collar}$ – Pressure to open port collar
- $P_{actuation, ECP}$ – Pressure inside casing string required inflate external casing packer.
- Working pressure – Pressure actuation on equipment, once operational.
- Service Shifting Tool – Tool used to operate stage collar, conveyed by drillpipe.



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4 FUNCTIONAL AND TECHNICAL REQUIREMENTS

4.1 Stage collar ensemble

4.1.1 The term stage collar ensemble will denote a stage collar and an inflatable packer, installed right below the collar. This packer can be dismissed from the ensemble, if requested by Petrobras.

4.1.2 If pup joints are necessary to compose the ensemble, or to perform a connection transition to the casing string, Petrobras can chose to be responsible for directly procuring these joints, if that will expedite delivery of the ensembles, or reduce their cost.

4.1.3 The ensemble must allow opening and closing of a string-to-annular communication, as commanded, enabling the cement to be pumped to the annular space between casing and open-hole, hereinafter called B-annulus. After the conclusion of the cement job, the stage collar must be permanently closed, composing an element of barrier, in the casing path. It must be compatible with one of the tubulars below:

4.1.3.1 Nominal OD = 9 7/8" ; Linear weight = 66.9 lb/ft

4.1.3.2 Nominal OD = 10 3/4" ; Linear weight = 65.7 lb/ft

4.1.3.3 Nominal OD = 10 3/4" ; Linear weight = 85.3 lb/ft

4.1.3.4 Nominal OD = 10 3/4" ; Linear weight = 109 lb/ft

4.1.3.5 Nominal OD = 13 5/8" ; Linear weight = 88.2 lb/ft

4.1.4 The specification of the ensemble must follow Table 1 , Table 2 and Table 3. Such specifications can vary, depending on the contracting scenario. Different limits can be requested, on ET-RBS.



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Table 1 – Specifications for stage collar ensemble (9 7/8" to 10 3/4") with wide Outside Diameters.

	Ensemble for 9 7/8", 66.9 lb/ft, wide OD	Ensemble for 10 3/4", 65.7 lb/ft, wide OD	Ensemble for 10 3/4", 85.3 lb/ft, wide OD	Ensemble for 10 3/4", 109 lb/ft, wide OD
Maximum external diameter for stage collar ensemble	11.69 in	11.778	11.778	11.755 in
Minimum passage assurance (<i>drift</i>)	8 1/2 in	9.5 in	9 in	8,528 in
Minimum Yield Strength	110 ksi	110 ksi	110 ksi	110 ksi
Minimum resistance to traction	2,100 klb	2,088 klb	1,919 klb	1,950 klb
Minimum resistance to compression	2,100 klb	2,088 klb	2,467 klb	1,950 klb
Minimum resistance to collapse (P _{external})	9,900 psi	9,540 psi	11,560 psi	9,900 psi
Minimum resistance to burst (P _{internal})	10,000 psi	10,000 psi	10,000 psi	10,000 psi
Open hole diameter	Up to 12 1/4"	Up to 14 3/4"	Up to 14 3/4"	Up to 12 1/4"
Maximum wash-out tolerance (in diameter)	2"	2"	2"	2"

Table 2 – Specifications for stage collar ensemble (9 7/8" to 10 3/4") with restricted Outside Diameters

	Ensemble for 9 7/8", 66.9 lb/ft with restricted OD	Ensemble for 10 3/4", 109 lb/ft with restricted OD
Maximum external diameter for stage collar ensemble	11.25 in	11.25 in
Minimum passage assurance (drift)	8 1/2 in	8,528 in
Minimum Yield Strength	110 ksi	110 ksi
Minimum resistance to traction	2,100 klbf	1,950 klb
Minimum resistance to compression	2,100 klbf	1,950 klb
Minimum resistance to collapse (Pexternal)	9,900 psi	9,900 psi
Minimum resistance to burst (Pinternal)	10,000 psi	10,000 psi
Open hole diameter	Up to 12 1/4"	Up to 12 1/4"
Maximum wash-out tolerance (in diameter)	2"	2"

Table 3 – Specifications of stage collar ensemble for Intermediate casing (13 5/8")

	Ensemble for 13 5/8", 88,2lb/ft, standard pressure limits	Ensemble for 13 5/8", 88,2lb/ft, extended pressure limits
Maximum external diameter for stage collar ensemble	15.125"	15"
Minimum passage assurance (drift)	12 1/4"	12 1/4"
Minimum Yield Strength	110 ksi	110 ksi
Minimum resistance to traction	2,246 klbf	2,246 klbf
Minimum resistance to compression	2,808 klbf	2,808 klbf
Minimum resistance to collapse (Pexternal)	4,490 psi	6,370 psi (*)
Minimum resistance to burst (Pinternal)	8,000 psi	8,830 psi (*)
Open hole diameter	Up to 17 1/2"	Up to 17 1/2"
Maximum wash-out tolerance (in diameter)	3"	3"

* For ensembles with extended pressure limits, burst and collapse requirements can be lowered, on ET-RBS, according to contracting scenario.



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- 4.1.1 The traction and compression limits on tables 1, 2 and 3 refer to elastic regime only. No yield is admissible up to these values.
- 4.1.2 If H₂S service is required, ISO 15156 must be complied with.
- 4.1.3 The steel grades employed must be sufficient to withstand corrosive environments according to ET-RBS. One typical corrosive environment, at Petrobras, is of 200 ppmV of H₂S, with pH of 4.3.
- 4.1.4 Elastomeric materials must be qualified according to ET-3000.00-1210-130-PPQ-1. The fluids used and test details will be specified on ET-RBS.
- 4.1.5 Connections of all tubulars of the ensemble will be detailed on ET-RBS.
- 4.1.6 The inflatable packer can be actuated hydraulically (by exertion of internal pressure) or mechanically (by traction / compression).
- 4.1.7 For hydraulically actuated packers, the nominal actuating pressure must be above 1,500 psi and below 2,000 psi. The packer design must allow configuration of the opening and closing pressure within this range, according to operator project for casing and cement job.
- 4.1.8 The maximum allowed tolerance for the actuation pressures is of ± 10%.
- 4.1.9 For mechanically actuated packers, the axial force for deployment must be fall in the range between 50 kbf and 70 kbf. The maximum tolerance for fluctuations in actuation force is ± 10%.
- 4.1.10 The inflatable packer must be capable of being set inside open holes, accounting for overgauge. The maximum expected open hole diameters, considering wash-out, are listed on Table 4.

Table 4- Geometry for testing inflatable packer.

OD / nominal weight of stage collar ensemble	OD of external pipe (inches) , for testing inflatable element
9 7/8", 66.9 lb/ft	14.25
10 3/4" ; 85.3 lb/ft	14.25
13 5/8", 88,2 lb/ft	20.5

- 4.1.11 The differential pressure to be withstood by the packer must consider the maximum diameter, that is, in a washed-out well. This differential pressure will be informed on ET-RBS. Here are some possible choices:



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4.1.11.1 1,200 psi, for standard cement operations

4.1.11.2 2,000 psi, for extensive cement operations

4.1.12 The packer must be qualified according to API SPEC 19OH, validation grade V2OH, ISO 14310, validation grade V5, or API SPEC 11D1, validation grade V5. Stricter grades will also be accepted, for each of the standards mentioned.

4.1.12.1 Depending on the contracting scenario, ET-RBS can demand other validation grades, such as API SPEC 11D1 V4 (liquid test plus axial loads)

4.1.12.2 Work pressure will be specified on ET-RBS.

4.1.12.3 Suggested temperature for testing is 90°C. However, packer must be able to operate according to item 4.1.14.

4.1.13 The stage collar and inflatable packer can be mounted on separated casing joints, as long as the resistance and connection criteria are met, for each tubular.

4.1.14 The stage collar ensemble must be projected to operate in any depth, for the following operational envelope:

4.1.14.1 Temperature: 4°C (Ti) - 140°C (Tf)

4.1.14.2 Maximum absolute pressure (Pa): 16,500 psi;

4.1.14.3 Possibility of application in vertical, directional or horizontal wells. The equipment must be capable of operating in dogleg severities of, at least, 5° / 100 ft.

4.1.15 The equipment design and the installation procedure (including support tools) must consider installation in subsea wells, for dynamic position rigs, in ultra-deepwater environments (up to 3.000 m of water depth).

4.1.16 The stage collar ensemble must have maximum length of 10 meters (34.81 ft). The ensemble must have free extremities, up to 1 meter (3.481 ft) from each termination. This intends to enable the coupling of handling racks and torque thongs.

4.1.17 The cement operation with the stage collar must be performed after setting the inflatable element, without the need to perform any additional trip.

4.1.18 Discrepancies or alternatives with regard to what was originally specified by Petrobras must be explicitly indicated, in a separate item of the vendor's Technical Purpose.

4.1.19 During its installation, along with the casing string, the collar must remain at closed position. It must also remain closed during the first stage cement job.

4.1.20 Mechanically actuated port collars must be able to open while experiencing a pressure differential of 500 psi, from the inside to the outside.



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- 4.1.21 After the second stage cement job, the collar must be actuated to the closed position. The collar internal profile must prevent it from opening, unless engaged by specific service tool.
- 4.1.22 The collar must possess a permanent-close mechanism, to be actuated after the second cement job. It is preferable for such mechanism to be activated on the same trip as the one performed for the second stage cement job.
- 4.1.23 After permanently closed, the collar must, remain closed. The collar must not open involuntarily, during subsequent operations, such as:
 - 4.1.23.1 BHA deployment
 - 4.1.23.2 Drilling of the next phase
 - 4.1.23.3 Casing tests, or internal pressurizing.
- 4.1.24 The stage collar sealability, after it has been permanently closed, cannot be affected by the drilling of the next phase.
- 4.1.25 The stage collar design must enable mechanical segregation between the cement slurry and spacer fluid, in order to avoid slurry contamination.
- 4.1.26 The holes drilled on collar body, which allow cement to be pumped to the annulus, must have, at least, 1 1/4" in diameter each. It is required, at least, 4 orifices (which add up a drilled surface of 4,9 in²). In order to allow a more homogeneous flow, on the azimuthal direction, the orifices are required to have an azimuthal offset, between one another.
- 4.1.27 Supplier must provide one operational envelope for each of the components of the stage collar ensemble (one for the inflatable packer and one for the stage collar). The envelopes must be given in the shape of a 2D-plot, similar to the operational efficiency envelopes of API 5C5 tubulars (see Figure 1).

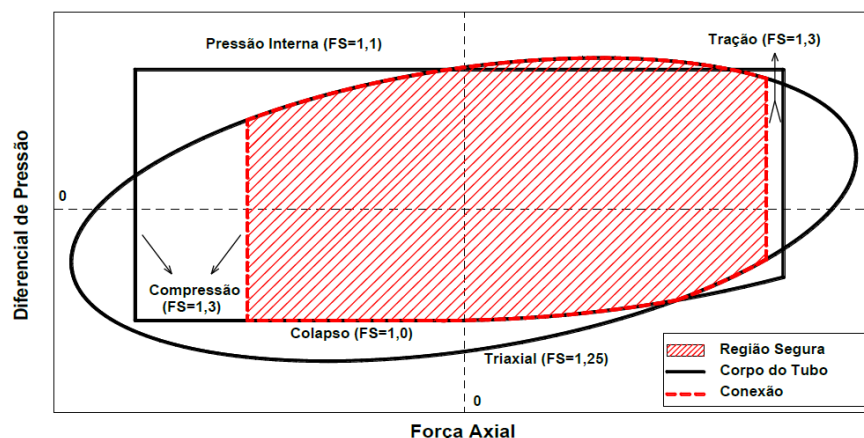


Figure 1 - Example of Von Mises envelope and API thresholds.



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4.1.28 At ambient temperature (20°C), the stage collar must be able to withstand pressure and axial loads, according Tables 1, 2 and 3.

4.2 Shifter tool

4.2.1 The Shifter Tool consists in a tubing-conveyed accessory which allows will actuate the collar, either by rotation or translation.

4.2.2 The maximum OD of the shifter toll must be compatible with 16 3/4" wellhead systems, with surface casing drifts (Table 1 ; Table 2 ; Table 3) and, evidently, with the drift of stage collar ensemble. The drift of such systems will informed n ET-RBS. Here are some possible values:

4.2.2.1 16"

4.2.2.2 18 1/8"

4.2.3 The profile or dogs mounted over the shifter tool must have a higher hardness than surface casing and stage collar interior, so that it won't wear out during stage collar actuation.

4.2.4 Connections must be compatible with workstring drillpipes. Such connections will be specified on ET-RBS. Here are some possible choices.

4.2.4.1 4 1/2" IF 13,5 lb/ft box x pin;

4.2.4.2 6 5/8" 28 lb/ft box x pin;

4.2.5 Internal pressure (burst) resistance: 7,500 psi;

4.2.6 External pressure (collapse): 7,500 psi;

4.2.7 Tension / compression limits for shifter tool will be specified on ET-RBS, so that they can meet the limits of the work string. Values typically encountered in Petrobras rigs are listed below.

4.2.7.1 Minimum tension limit = 400 kbf;

4.2.7.2 Minimum compression limit = 200 kbf;

4.2.8 For mechanically actuated stage collars, the shifter tool must possess flow-rerouting mechanisms, in order to:

4.2.8.1 Enable circulation and cementing by drillstring extremity, for 1st stage cement job, while preventing unwanted leakage to annular space between shifter tool and casing (hereinafter called A-annulus).



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- 4.2.8.2 Enable circulation and cementing through stage collar, while ensuring isolation of drillstring extremity, therefore, preserving 1st stage cement job. In addition, during the 2nd stage cement (through collar), all flow must be directed to the B-annulus, ensuring that there's no upward or downward flow in A-annulus.
- 4.2.9 The shifter tool must allow for sealing tests to be performed, on the chamber between tool communication port and casing bore. This test must be performed prior to cement job, to ensure realization of items 4.2.8.1 and 4.2.8.2.
- 4.2.10 The shifter tool must possess mechanisms to avoid well surge or swab, during its trip-in or trip-out procedures.



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4.3 Translational actuation

- 4.3.1 Collars with translational actuation are those in which actuation is given by translation of shifter tool, relative to stage collar. These collars must open when moved downwards (open down) and close, if switched upward (close up);
- 4.3.2 The minimum force required, for both opening and closing of stage collars, must be of 50 klb. This value aims intends to provide operator with enough measuring sensibility, on Martin -Decker. The necessary force, for opening and closing stage collars, must be smaller than 70 klb.
- 4.3.3 The stage collar must possess a permanently closed position (lock-closed), that once triggered will prevent collar from re-opening.

4.4 Rotational actuation

- 4.4.1 Collars with rotational actuation are those in which a shifter tool opens or closes the collar, by rotating in reference to it.
- 4.4.2 The minimum torque required, for both opening and closing of stage collars, must be of $2 \text{ klb} \cdot \text{ft}$. This value aims intends to provide operator with enough measuring sensibility, on top-drive.
- 4.4.3 The maximum torque allowed, for both opening and closing of stage collars, is $15 \text{ klb} \cdot \text{ft}$. This value aims to avoiding over-torqueing connection threads in workstring;

4.5 Combined actuation

- 4.5.1 This item refers to collars which rely on both rotation and translation of the shifter tool, to open or close. In this case, premises on items 4.3 and 4.4 must be respected.

4.6 Hydraulic actuation

- 4.6.1 This item refers to collars that are open or closed by the application of pressure inside casing string. The collar design must require a dart, plug or sphere to be pumped downhole, before the collar starts to open.
- 4.6.2 Nominal opening pressure for stage collars must remain between 2,400 psi and 3,500. Actual opening pressure for the collar must fall within a $\pm 10\%$ range of the nominal value.
- 4.6.3 Nominal closing pressure for stage collars must remain between 1,200 psi and 1,800 psi. Actual closing pressure for the collar must fall within a $\pm 10\%$ range of the nominal value.



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$$\min\{P_{open, collar}\} > \max\{P_{actuation, ECP}\} + 700 \text{ psi} \quad (4.1)$$

- 4.6.4 The difference between maximum pressure to inflate ECP and minimum opening pressure for the stage collar must be, at least, 700 psi. This is mathematically stated on Eq. (4.1) and intends to prevent the collar from opening before the ECP is completely inflated.
- 4.6.5 For hydraulically actuated ECPs, the minimum inflation pressure of the ECP must be greater than 1,500 psi. This intends to allow the first stage cement job to be executed without disturbances.
- 4.6.6 After the conclusion of the second stage cement job, system must be internally drillable with PDC or tricone bit without need to mill out. The resulting drift must respect the required drift on Table 1, Table 2 and Table 3.



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4.7 Stage collar accessories

- 4.7.1 If the stage collar operation requires pumping plugs, darts or spheres, such elements must respect items 4.7.2 to 4.7.4.
- 4.7.2 All accessories must be compatible with drillpipes, to be defined on ET-RBS (e.g.: 5" ; 6 5/8"); For that matter, accessories must observe diameter restrictions of drillstring tubes; Those restrictions typically vary from 2.750 pol to 5.901 pol).
- 4.7.3 Darts for the same function must be identically built, with interchangeable rubber parts.
- 4.7.4 Darts for different functions must have different colors and clear labels, on its fins.

4.8 Installation service

- 4.8.1 Supplier must participate on planning of operations, from the moment that the accessories and tools arrive to rig-site.
- 4.8.2 Supplier must follow collar operations on the rig. Personnel involved must be qualified for the necessary tasks. Technicians in charge must follow all steps of operation, including installation, collar opening, cementing and collar closing.
- 4.8.3 If a failure event is observed, on any component of the collar ensemble, Petrobras must be promptly notified.



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5 QUALIFICATION TESTS

5.1 General requirements

- 5.1.1 All equipment must be qualified, through factory tests. These tests must ensure compliance with the present technical specification. Tests must also enable suitability to transport, storage, installation and operation requirements of all products.
- 5.1.2 Qualification must contain, at least, tests described on this section, for reference, and equipment rating. Any additional test employed must be reported.
- 5.1.3 Description of all tests and corresponding results must be reported, as well as inspection and traceability data for the utilized materials.
- 5.1.4 Supplier must execute the tests hereby described, with the supervision of an independent certifying agency; Tests must be done at supplier's cost. Petrobras must be allowed to witness and follow each and any of the tests.
- 5.1.5 Should a qualified equipment undergo any change on its technical specifications, this equipment must be, once again, analyzed and accepted by Petrobras.
- 5.1.6 If the modifications mentioned on 5.1.1.5 are deemed as significant, by Petrobras, a new qualification process must be executed and presented, so that the modified product can obtain qualification.
- 5.1.7 Items 5.2 and 5.3 describe acceptance tests which are mandatory for contracting.
- 5.1.8 Supplier must present, prior to the tests, fabrication tolerances applicable to the stage collar dimensions. A specimen must be chosen in order to represent worst case geometry that can be produced in the assembly line.



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5.2 Functional test

- 5.2.1 Command opening of the port collar.
- 5.2.2 For mechanically actuated collars, test must be executed with shifter tool engaged inside port. Collars will be actuated by shifter, to reproduce what would happen on downhole.
- 5.2.3 Acceptance criterium: Verification of complete opening of the ports.
- 5.2.4 Command closing of the port collar, to permanent lock position.
- 5.2.5 Acceptance criteria
 - 5.2.5.1 For mechanically actuated collars, opening or closing forces must of, at least, 45 klbf.
 - 5.2.5.2 For hydraulically actuated collars, opening or closing pressures must stay near the design values and fall within a $\pm 10\%$ range.
 - 5.2.5.3 Verify complete closure of collar orifices. No visible damage is admitted until this step. This applies to both metallic non-metallic components.



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5.3 Sealing test

- 5.3.1 Keep system temperature at $50^{\circ} C \pm 3^{\circ} C$ ($120^{\circ} F \pm 5^{\circ} F$).
- 5.3.2 Apply pressure differential equivalent to P_{internal} , from inside to outside of stage collar, during, at least, 15 min. Please refer to Tables 1, 2 and 3, for P_{internal} .
- 5.3.3 Apply pressure differential equivalent to P_{external} , from outside to inside of the collar, during, at least, 15 min. For hydraulically actuated collars, which use a plug and baffle, two downstream chambers must be monitored: inside the collar, downhole-side and inside the collar, surface-side.
- 5.3.4 Acceptance criterium: For each of the steps 5.3.2 and 5.3.3, the maximum pressure fall rate allowed is of 1% of the pressure differential between upstream chamber (the one being pressurized) and downstream chamber (those being monitored), for a 15 min time interval. This criterium is similar to the one described on ISO 14998, Annex A, item A.3. One must not supply the upstream chamber with pressure, during the test. A hold period can be awaited, for pressure stabilization, before the 15 minutes are counted.
- 5.3.5 Report upstream and downstream chambers volumes, on test report, for each of the steps 5.3.2 and 5.3.3.
- 5.3.6 Cool down system to $10^{\circ} C \pm 3^{\circ} C$.
- 5.3.7 Repeat steps 5.3.2 and 5.3.3, for $10^{\circ} C \pm 3^{\circ} C$.
- 5.3.8 Acceptance criterium: the maximum pressure fall rate allowed is of 1% of the pressure on the upstream chamber (the one being pressurized), for a 15 min time interval. This criterium is similar to the one described on ISO 14998, Annex A, item A.3. One must not supply the upstream chamber with pressure, during the test. A hold period can be awaited, for pressure stabilization, before the 15 minutes are counted.
- 5.3.9 Report upstream and downstream chambers volumes, on test report, for each of the steps 5.3.2 and 5.3.3 (this time, at $10^{\circ} C \pm 3^{\circ} C$).



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6 PRODUCTION INSPECTION

Requirements for inspection and production for stage collars purchases can be found on the technical specification ET-3000.00-1000-972-P8L-001. This spec can be obtained on Petrobras Supplier Channel

(<http://sites.petrobras.com.br/CanalFornecedor/portugues/requisitocontratacao/requisitocotratacao.asp>)



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7 DOCUMENTATION

All documents must be available in electronic media using PDF format. The documents described in this section are scope of supply and must be available to Petrobras approval.

- 7.1 Detailed operational procedures for installing the collars.
- 7.2 Complete mechanical drawing of the entire equipment, containing dimensions and enough technical details, so that the design can be appraised in reference to this TS-R
- 7.3 Mechanical drawings for each component, including dimensions and enough technical details, to support installation and fishing operations.
- 7.4 Technical manual for each component, containing, at least: part number, description, materials utilized during production, operational envelope and report for qualification tests.
- 7.5 Calculation memorial, for sizing of each component.
- 7.6 If supplier possesses ISO 14998 or ISO 14310 qualification for the collar, related documentation must be presented
- 7.7 Specification of elastomeric materials and choice criterium.
- 7.8 Description of equipment, tools and accessories.
- 7.9 FMECA (Failure Mode, Effects and Criticality Analysis), to be composed in cooperation with Petrobras technicians.

OBS.: Studies and calculation memorials must be included in reports, which will constitute part of the supplying scope.

- 7.10 List of sub-components and equipments, with name of corresponding vendors (sub-suppliers), model, application and indication whether the referred part is a prototype or not.
- 7.11 All drawings must be on A3 format.
- 7.12 Section containing list of expected dimensional deviations, inherent to factory uncertainties (if applicable).