

 PETROBRAS	TECHNICAL SPECIFICATION					I-ET-3000.00-1210-25B-PPQ-001				
	PROGRAM:	Wells					Sheet 1 of 11			
	AREA:	Well structure					-			
POCOS/EP/ITC	TITLE:	Welding Service Requirements for Marine Well Structure Materials					PUBLIC			
							POCOS/EP/ITC			
REVIEW INDEX										
REV.	DESCRIPTION AND/OR LEAVES AFFECTED									
0	Original issue. This ET is based on ET-2000.00-1180-211-PSQ-001 Rev. C and replaces it in the Petrobras Well Area.									
A	Addition of New Diameters and Materials in the Table of Components and their Respective Materials.									
B	Inclusion: ISO 9712:2012 requirements, ASTN definition, NIST, RBLE, SSC. Changes to the wording of items 5.4, 6.4.1, 7 and 8.									
C	Changes to the wording of items 5.4, 6.1.6, 6.3.3, 6.3.5, 6.4.6 and 6.4.10.									
D	Replacement of ET inspection requirements and inclusion of material classes for welding.									
E	Inclusion of welding requirements on one side to comply with DNV Curve C1.									
F	Amendment of item 6.1.6 and inclusion of an additional paragraph to item 6.1.11.									
G	Amendment of items 3.8, 5.5.4, 6.1.1, 6.4.3 and 6.4.6 and insertion of item 3.16.									
H	Removal of item 5.3.5 - ANP requisites of SST									
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H	
DATE	18/07/2018	07/08/2018	16/08/2018	14/12/2018	08/05/2019	03/06/2022	06/01/2023	01/09/2023	13/06/2025	
PROJECT	CTPS/QC	CTPS/QC	CTPS/QC	CTPS/QC	CTPS/QC	POCOS/EP/ITC/ETP	POCOS/EP/ITC/ETP	POCOS/EP/ITC/ETP	POCOS/EP/ITC/ETP	
EXECUTION	SEQUI	SEQUI	SEQUI	SEQUI	SEQUI	SPO/PEP/PROJ-PERF	SPO/PEP/PROJ-PERF	SPO/PEP/PROJ-PERF	SPO/PEP/PROJ-PERF	
VERIFICATION	SPO/SPO/PROJ-EP	SPO/SPO/PROJ-EP	SPO/SPO/PROJ-EP	SPO/SPO/PROJ-EP	SPO/SPO/PROJ-EP	CENPES/PDIDP/TIA/TMI	CENPES/PDIDP/TIA/TMI	CENPES/PDIDP/TIA/TMI	CENPES/PDIDP/TIA/TMI	
APPROVAL	CTPS/QC	CTPS/QC	CTPS/QC	CTPS/QC	CTPS/QC	EP/ITC	EP/ITC	EP/ITC	EP/ITC	
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FORM BELONGING TO PETROBRAS										

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 2 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<div>SUMMARY</div> <div><div>1</div><div>INTRODUCTION</div><div>3</div></div> <div><div>2</div><div>SCOPE</div><div>3</div></div> <div><div>3</div><div>REFERENCE DOCUMENTS</div><div>4</div></div> <div><div>4</div><div>ACRONYMS OR ABBREVIATIONS</div><div>5</div></div> <div><div>5</div><div>DESCRIPTION OF TECHNICAL REQUIREMENTS.....</div><div>6</div></div> <div><div>6</div><div>ADDITIONAL TECHNICAL REQUIREMENTS.....</div><div>8</div></div> <div><div>7</div><div>DOCUMENTATION.....</div><div>13</div></div>			

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 3 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC


1 INTRODUCTION

This ET-R was prepared based on ET-2000.00-1180-211-PSQ-001 Rev. C and replaces it in the Petrobras Wells Area; it was validated by a multidisciplinary technical group from the Petrobras Wells Area in compliance with Law 13.303/16. ET-2000.00-1180-211-PSQ-001 Rev.C belongs to the now-defunct Manufacturing, Construction and Assembly Technology department (SEQUI).

2 SCOPE

Technical Specification of Requirements for Welding Services of Maritime Well Structure Materials Production Pipes, such as **Qualification, Execution and Inspection** of welded joints between surface casing pipes, connectors, housings and accessories.

This specification is limited to the following components and their respective materials:


 PETROBRAS	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 4 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC

Component	Material Classification
Plate	ASTM A36 or A516 Gr 60
Concentric reduction	ASME B16.9 ASTM A420 WPL8
Connectors	AISI4130 56ksi/60ksi and AISI 8630 90ksi/95ksi/100ksi
Housing 20"	AISI 8630 85ksi, ASME IX Pn1/Gn2 56ksi, SAE 4340, API 5L X80, API 5L X70, API 5L X56 and ASTM A694 F65
Housing 22"	ASME IX Pn1/Gn4 70ksi/80ksi, SAE 4340, API 5L X80, API 5L X70, API 5L X56 and ASTM A694 F65
Housing 30"	AISI 4130 60ksi/65ksi, ASTM A 694 F65, ASTM A 694 F60, AISI 8630 100ksi, API 5L X56 and API 5L X65
Housing 36"	AISI 4130 52ksi/65ksi, ASME IX Pn1/Gn4 80ksi, ASTM A 694 F65, API 5L X65, ASTM A 694 F60 and AISI 8630 100ksi
Housing 42"	AISI 4130 52ksi/60ksi and ASTM A 694 F65
Support Sub/ <i>Buttweld</i>	AISI 8630 85ksi, API 5L X80 and API 5L X70
16" x 0.495" tube	API 5CT N-80
16" x 0.589" tube	API 5CT N-80
18" x 7/8" tube	API 5L GR - X80
20" x 5/8" tube	API 5L GR - X56 and X80
20" x 3/4" pipe	API 5L GR - X80
20" x 1" tube	API 5L GR - X56 and X70
22" x 1" tube	API 5L GR - X70 and X80
22" x 1 1/8" tube	API 5L GR - X70 and X80
22" x 0.812" tube	API 5L GR - X70 and X80
30" x 1 1/2" pipe	API 5L GR - B, X60 and X80
30" x 1" tube	API 5L GR - B and X60
36" x 2" tube	API 5L GR - X60 and X80
36" x 1 1/2" pipe	API 5L GR - B, X60 and X80
42" x 1" tube	API 5LX GR B

For welding materials not listed above, additional requirements may be necessary. In this case, PETROBRAS should be consulted.

3 REFERENCE DOCUMENTS

- 3.1 **ABNT NBR 14842:2015** - Welding - Criteria for the qualification and certification of inspectors for the oil and gas, petrochemical, fertilizer, naval and thermogeneration (except nuclear) sectors
- 3.2 **API SPEC 5L 45th edition** - Specification for Line Pipe
- 3.3 **API SPEC 6A Ed. 2010** - Specification for Wellhead and Christmas Tree Equipment

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 5 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC

3.4 **API SPEC Q1 Ed. 2013** - Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry

3.5 **API SPEC 8C** - Drilling and Production Hoisting Equipment

3.6 **API RP 5C6 Ed. 2012** - Welding Connections to Pipe

3.7 **ASME BPVC Sec. IX Ed. 2015** - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators

3.8 **DNV-RP-C203 Ed. 2019 am. 2021** - Fatigue design of offshore steel structures

3.9 **ISO 9001:2015** - Quality management systems - Requirements

3.10 **ISO 9712:2012** - Non-destructive testing - Qualification and Certification of NDT personnel

3.11 **ISO 17024:2012** - General requirements for bodies operating certification of persons

3.12 **ISO 17025:2017** - General requirements for the competence of testing and calibration laboratories.

3.13 **ISO/TS 29001:2010** - Petroleum, petrochemical and natural gas industries -- Sector-specific quality management systems -- Requirements for product and service supply organizations

3.14 **NACE MR 0175 Ed. 2014** - Materials for use in H₂ S-containing environments in oil and gas production

3.15 **I-ET-0000.00-0000-972-1AL-001** - Quality of Goods General Requirements.

3.16 **N-2941** - Personal Skills in Inspection Activities

4 ACRONYMS OR ABBREVIATIONS

ABNT - Brazilian Association of Technical Standards

API - American Petroleum Institute


ASME - American Society of Mechanical Engineers


ASTM - American Society for Testing and Materials


ASNT - American Society for Nondestructive Testing

DNV - Det Norske Veritas

ET-R - Technical Specification of General Requirements. It allows the supplier to know the general criteria for acceptance, testing and validation of a given system, equipment, material and/or service, which can be used in the verification phase of the effectiveness of technical proposals in tendering processes.

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 6 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>ET-RBS - Technical Specification for the Requisition of Goods and Services. It is a document that contains the specific technical requirements and supplementary instructions necessary to define the scope of the contract for the system, equipment, material and/or service.</p> <p>FMECA - Failure Mode, Effects and Criticality Analysis.</p> <p>ISO - The International Organization for Standardization.</p> <p>NACE - National Association of Corrosion Engineers.</p> <p>RBLE - Brazilian Network of Testing Laboratories.</p> <p>NIST - National Institute of Standards and Technology.</p> <p>RBLE - Brazilian Network of Testing Laboratories.</p> <p>SSC - Sulfide Stress Cracking</p>			
<h2>5 DESCRIPTION OF TECHNICAL REQUIREMENTS</h2>			
<p>5.1 The company or supplier must prove through technical reports, simulations, API monograms, certificates and/or technical documentation that it meets ALL the items of the functional, technical and complementary requirements of this ET-R. If the company or manufacturer does not meet any item(s), it must indicate and justify why it does not.</p>			
<p>5.2 The supplier undertakes to make available to Petrobras at least one (1) qualified professional with knowledge of the design of the equipment, its functionality and its installation, in order to carry out the FMECA and/or risk analysis of the component tasks of the installation of the equipment or provision of services.</p>			
<p>5.3 Welding and inspection must be carried out in accordance with API RP 5C6, with supplementary requirements SR26, SR27, SR30, SR31, SR33, SR34, SR36, modified in accordance with the requirements of this specification.</p>			
<p>5.3.1 Requirement SR29 is required for welding connectors or housings in 30" and 36" conductive coatings.</p>			
<p>5.3.2 The SR35 requirement is only required if compliance with NACE MR 0175 is specified by the project in the ET-RBS.</p>			
<p>5.3.3 The additional technical requirements described in this technical specification take precedence over the API RP 5C6 standard.</p>			

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 7 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>5.3.4 The Mechanical Testing Laboratory must be accredited by INMETRO and belong to the Brazilian Network of Testing Laboratories (RBLE) or to Testing Laboratories accredited by bodies with which INMETRO has mutual recognition agreements.</p> <p>5.3.4.1 American laboratories must be accredited by NIST.</p> <p>5.3.4.2 Other laboratories must be accredited to ISO 17025 for all their testing and calibration activities.</p> <p>5.3.5 Foreign laboratories must be accredited by NACE.</p> <p>5.4 When the design specifies fatigue curve C1 of DNVGL-RP-C203 for the circumferential weld on the ET-RBS, the fabrication requirements of Annex A of DNV-RP-C203 must be met, i.e., welding must be carried out on both sides in a flat (rotating) or horizontal position and the weld reinforcement and any surface defects must be removed by machining or grinding on both sides.</p> <p>5.4.1 The maximum roughness should be 3.2 µm (RA).</p> <p>5.4.2 The maximum misalignment must be specified in the contract documents. The welded joint must have a smooth transition with a thickness of not less than 1:4.</p> <p>5.5 With reference to item 5.4welding on one side is permitted provided it meets the following requirements:</p> <p>5.5.1 Inability to access the internal surface for welding.</p> <p>5.5.2 Full compliance with all details and requirements applicable to Category C1 and description 8 of Table A-9 of DNV-RP-C203.</p> <p>5.5.3 The machining of the specimen (CP) must guarantee the removal of at least 0.2 mm below any imperfection on the edges of the weld or at the root.</p> <p>5.5.4 Inspection of the entire length of the welds on the inner surface by magnetic particle testing, with the ability to detect indications up to 0.1 mm high and with the ability to detect indications up to 0.3 mm high along the entire circumference by ultrasonic testing.</p> <p>5.5.4.1 Any indication found should be considered unacceptable.</p>			

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 8 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC

5.5.4.2 NDT procedures subject to approval by Petrobras.

5.6 The minimum manufacturing inspection requirements to be met in direct or indirect purchases are described in I-ET-0000.00-0000-972-1AL-001. The technical requirements of this ET-R take precedence over I-ET-0000.00-0000-972-1AL-001.

5.6.1 For the provision of services, the role of the manufacturing inspector will be the responsibility of the contract supervisor or someone appointed by him. The level of involvement in the execution of services will be defined by the contract supervisor for the purposes of measuring services and quality assurance.

5.6.2 The manufacturing facility must be qualified to meet the quality management systems for the oil and gas industry (API SPEC Q1 / ISO/TS 29001).

5.7 In addition, qualification records for welding procedures and welders, welding procedures and non-destructive testing must be certified by third party inspection when contractually required.


6 ADDITIONAL TECHNICAL REQUIREMENTS


6.1 QUALIFICATION OF WELDING PROCEDURES


6.1.1 Qualification of personnel: The welding procedure must be qualified by a level 2 welding inspector in accordance with ASME B31.3, ASME B31.4 or ASME B31.8, certified in accordance with ABNT NBR 14842:2015.

6.1.2 Personnel qualification: If welding is carried out outside BRAZIL, certification must be issued by an independent body accredited to ISO 17024. Equivalence with welding inspector level 2 must be verified in accordance with standard N-2941.

6.1.3 Material grouping: For welding low-alloy steel and API 5L/5CT pipes with a yield strength of 60 ksi or more, an increase in the material grade, a change in the delivery condition and a variation in the chemical composition (%C, P_{cm} and C_{eq}) above what is permitted must be considered as essential variables in the qualification of the welding procedure.

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 9 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>6.1.3.1 An increase of a maximum of 0.03 in %C; 0.02 in Pcm (for materials with %C up to 0.12) and 0.03 in Ceq (for materials with %C greater than 0.12) is allowed, based on product analysis, without the need to requalify the procedure.</p> <p>6.1.3.2 For the supply of services, PETROBRAS will supply the additional basic materials necessary for the qualification of the welding procedure for equipment or components not supplied by the CONTRACTED PARTY.</p> <p>6.1.3.3 Welding should only proceed if the specified minimum properties are achieved.</p> <p>6.1.4 Welding consumables: For welding low-alloy steel and API 5L/5CT pipes with a yield strength of 60 ksi or more, the diffusible hydrogen content in the consumable must be less than 8 ml / 100 g of deposited metal.</p> <p>6.1.4.1 In all cases, welding consumables with a G suffix will not be accepted without the presentation of the manufacturer's technical specification containing the limits of the consumable's chemical composition and mechanical properties. In this case, the trademark is considered an essential variable.</p> <p>6.1.4.2 Consumables must be supplied with an EN10204 type 3.1 or AWS 5.01 schedule J certificate, with the exception of flux for the SAW process. The tensile, impact, chemical composition and diffusible hydrogen values of the batch must be shown on the respective certificates.</p> <p>6.1.5 Hardness test (SR26): When not specified by the design in the ET-RBS, the maximum permissible value is 35 HRC or 350HV10 measured on the weld metal and thermally affected zones of the pipe and connector in carbon and low alloy steel to avoid hydrogen embrittlement under cathodic protection.</p> <p>6.1.6 Impact test (SR27): The assemblies must be removed from the weld metal, fusion line, fusion line + 2mm and fusion line + 5mm at 1.5mm from the external surface.</p> <p>6.1.6.1 When welding dissimilar materials, the fusion line assemblies must be removed from both sides of the weld.</p> <p>6.1.6.2 Additional assemblies must be included for the weld metal and fusion line at 1.5 mm from the inner surface when the thickness exceeds 25 mm or when more than one welding process is used.</p>			

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 10 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>6.1.6.3 Additional specimens on the inner surface should only be removed from the weld metal and fusion line.</p> <p>6.1.7 Stress relief heat treatment: When required by the welding procedure, it must be carried out in accordance with ASME BPVC Sec. IX and API SPEC 6A, PSL 3. For temperature control: follow the guidelines of AWS D10.10.</p> <p>6.1.8 Welding parameters: The variation in the average heat input of the pass must be considered an essential variable. A variation of $\pm 15\%$ of the values recorded in the qualification is permitted without the need to requalify the procedure.</p> <p>6.1.9 Preheating and interpassing: a reduction in the preheating temperature or an increase of more than 25°C in the interpassing temperature recorded in the qualification is not permitted. The maximum interpass temperature must not exceed 315°C.</p> <p>6.1.10 Non-destructive tests: The same non-destructive tests as for production welds must be carried out on the test coupon.</p> <p>6.1.10.1 Non-destructive tests on low alloy steels and API 5L/5CT pipes with a yield strength of 60 ksi or more, welded without post-heating, must be carried out 48 hours after welding.</p> <p>6.1.10.2 In all other cases, a minimum interval of 24 hours must be observed between welding and inspection.</p> <p>6.1.11 Tensile test: Breakage at the weld or below the specified minimum tensile strength (SMTS) for the base metal is not permitted.</p> <p>6.1.12 Repair: Specific procedures must be drawn up for repairing welds. Repair procedures must realistically simulate the repair situation to be qualified.</p> <p>6.1.12.1 If the joint is cut, it is permissible to use the original welding procedure as long as the entire heat-affected zone is removed.</p> <p>6.1.12.2 A procedure for cutting and resinating the bevel must be presented which ensures that the new bevel is at least 10 mm beyond the fusion line, guaranteeing complete removal of the HAZ.</p>			

 PETROBRAS	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 11 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC

6.2

QUALIFICATION OF WELDERS AND WELDING OPERATORS

6.2.1

In addition to the requirements of ASME BPVC Sec. IX Article 3, welders and welding operators must be able to reproduce the heat input range specified in the welding procedure.

6.3

PRODUCTION WELDING CONTROL

6.3.1

Personnel qualification: Welding monitoring must be carried out by a level 1 welding inspector, certified in accordance with ABNT NBR 14842:2015. If welding is carried out outside BRAZIL, certification must be issued by an independent body accredited to ISO 17024.

6.3.2

Welding Procedure Specification: No welding work should be started without prior approval of all welding documentation. The EPS must be fixed in a visible and easily accessible place in the welding station.

6.3.3

Misalignment: The coupling of circumferential joints should preferably be aided by the use of an internal or external coupler.

6.3.3.1

Misalignment must be measured with calibrated equipment on 100% of the circumferential joints before welding.

6.3.3.2

When not specified by the project in the ET-RBS, the maximum misalignment allowed in butt joints should be 1.6 mm on the inside and 3.2 mm on the outside.

6.3.3.3

For service supply, the use of bungs evenly distributed along the circumference and welded inside the bevel is permitted. Temporary welds must be carried out in accordance with the qualified procedure and removed. The incorporation of tack weld into the final weld is not permitted.

6.3.4


Preheating: The use of a cutting torch during preheating is not permitted.


6.3.5

Welding parameters: The thermal input must be monitored by calibrated instruments on 100% of the welds. The use of a supervisory system is recommended.

6.4

INSPECTION

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 12 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>6.4.1 Personnel qualification: Non-destructive testing must be carried out by an inspector certified by the National Qualification and Certification System.</p> <p>6.4.1.1 If welding is carried out outside BRAZIL, the personnel qualification process must meet the requirements of ISO 9712, at an independent body certified to ISO 17024.</p> <p>6.4.1.2 Self-certification schemes, such as the ASNT SNT TC-1A scheme, are not accepted, except when used to supplement the qualification of inspectors working with automated processes.</p> <p>6.4.2 Procedures: Non-destructive testing inspection procedures must be drawn up in accordance with ASME BPVC Section V and API SPEC 6A.</p> <p>6.4.3 Visual weld inspection: Welds must be inspected by a Level 1 welding inspector or a Level 2 Visual Weld Tester, after removing weld spatter, bites and other surface discontinuities.</p> <p>6.4.3.1 Method and acceptance criteria according to API SPEC 6A, PSL 2.</p> <p>6.4.3.2 For 20" and 22" pipes, the maximum reinforcement allowed must not exceed 1.6 mm. In other cases, the reinforcement will be lowered when necessary.</p> <p>6.4.4 Magnetic particles (SR30): Must be replaced by Liquid Penetrant when inspecting non-ferromagnetic materials or when the overlay scheme is not provided for in the procedure. Method and acceptance criteria conf. API SPEC 6A PSL 2.</p> <p>6.4.5 Radiography (SR29): Panoramic exposure (PSVS) should be used whenever possible. Method and acceptance criteria according to API SPEC 6A, PSL 3.</p> <p>6.4.6 Ultrasound (SR36): Required for butt penetration welds and full angle penetration welds. Method and acceptance criteria according to API SPEC 6A, PSL 3.</p> <p>6.4.6.1 X-ray inspection can be omitted if computerized ultrasound (<i>Phased Array</i> + ToFD) is used that is qualified according to ASME V, Article 4, Mandatory Appendices V and VII, in which case the use of Mandatory Appendix V, with the use of an encoder, is required, and the use of Mandatory Appendix IV, with manual scanning, is not acceptable.</p>			

	TECHNICAL SPECIFICATION	NO. I-ET-3000.00-1210-25B-PPQ-001	REV. H
	Well structure		Leaf 13 of 13
	TITLE: Welding Service Requirements for Marine Well Structure Materials		PUBLIC
			POCOS/EP/ITC
<p>6.4.6.2 And for the acceptance criteria of the <i>phased array</i> test, the use of Mandatory Appendix VII is required, and the use of Mandatory Appendix VIII is not acceptable. The PAUT procedure must be submitted for evaluation of the coverage of the "Scan Plan".</p> <p>6.4.6.3 Inspection with a normal/double crystal head in the scanning area can be carried out before coupling for circumferential welds.</p> <p>6.4.7 Hardness test (SR31): A portable instrument using the ultrasonic impedance method (UCI), according to ASTM A 1038, with a load of 5 kgf or 10 kgf, shall be used for field hardness measurement.</p> <p>6.4.7.1 When not specified by the design in the ET-RBS, the acceptance criterion must be a maximum of 350HV10 measured on the weld metal and thermally affected zones of the pipe and connector in carbon and low alloy steel.</p> <p>6.4.8 The extent of non-destructive testing on the weld must be: 100% Visual, 100% Magnetic Particle or Liquid Penetrant and 100% Radiography.</p> <p>6.4.8.1 Ultrasound must be carried out on 100% of the weld when specified in item 6.4.6.</p> <p>6.4.8.2 The hardness test must be carried out on 100% of the welds.</p> <p>6.4.9 Gauges (SR33): The external circumferential weld at the tip of the box-type connector must be checked by an external gauge. The caliper measurement is calculated as: minimum elevator diameter (according to API Spec 8C) minus 0.5 mm.</p> <p>6.4.10 Non-destructive testing of welds between low alloy steels and API 5L/5CT pipes with a yield strength of 60 ksi or more must be carried out 48 hours after welding. In all other cases, a minimum interval of 24 hours must be observed between welding and inspection. This requirement does not apply to post-heat welds.</p> <p>7 DOCUMENTATION</p> <p>7.1 The minimum documentation requirements to be met can be found in the technical specification I-ET-0000.00-0000-972-1AL-001 - QUALITY OF GOODS GENERAL REQUIREMENTS.</p>			