PETROBRAS	TECHNICAL SPECIFICATION	No. I-ET-3000.00-1200-955-P4X-002
	CLIENT:	SHEET 1 of 16
	PROJECT:	CC : -
	AREA:	
DP&T-SUP	TITLE: **REQUIREMENTS FOR WELDING INSPECTION**	NP-1 ESUP

MICROSOFT WORD / V.2013 / I-ET-3000.00-1200-955-P4X-002_0.DOCX

INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEET
0	ORIGINAL

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	AGO/17/18								
DESIGN	ESUP								
EXECUTION	MARCHON								
CHECK	MARIANO								
APPROVAL	JUVENTINO								

1 INTRODUCTION

This technical specification applies to the inspection of piping (metallic and non-metallic) and to the metallic structural components added to the Unit in order to support all the piping and related accessories.

2 NORMATIVE REFERENCES

The inspection requirements of the following normative references shall be fulfilled, as well as the additional requirements herein listed.

2.1 CLASSIFICATION

MANUFACTURER/PACKAGER shall perform the work in accordance with the requirements of Classification Society.

2.2 CODES AND STANDARDS

The following codes and standards contain provisions which, through reference in this text, constitute requirements for this specification. The latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below.

- API RP 945 - Avoiding Environmental Cracking in Amine Units;
- ASME B31.1 - Power Piping;
- ASME B31.3 - Process Piping;
- ASME B16.5 - Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24;
- ASTM E384 - Standard Test Method for Knoop and Vickers Hardness of Materials;
- AWS D1.1 - Structural Welding Code – Steel;
- ISO 3834-2 - Quality requirements for fusion welding of metallic materials-Part 2: Comprehensive quality requirements;
- ISO 15156 - Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production;
- ASTM A1038 - Standard Test Method for Portable Hardness Testing by the Ultrasonic Contact Impedance Method.

Governmental codes, regulations, ordinances or rules applicable to the equipment in Brazil shall prevail over the requirements of above specification, including reference codes and standards and/or this Technical Specification, only in those cases where they are more stringent.

2.3 REFERENCE DOCUMENTS

I-ET-3000.00-1200-955-P4X-001 – WELDING

I-ET-0000.00-0000-970-PSQ-001 – PROCEDURE AND PERSONNEL QUALIFICATION AND CERTIFICATION

2.4 CONFLICTING REQUIREMENTS

In case of conflicting information between this Technical Specification and the referred applicable standards, this Specification shall prevail.

In case of conflicting information between this Specification and other specific PURCHASER's Document (Data Sheet or Equipment List) see the document basic design documentation priority guidelines, if applicable.

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

Can: Can requirements are conditional and indicate a possibility open to the user of the standard.
May: May indicates a course of action that is permissible within the limits of the standard (permission).
Shall: Shall is an absolute requirement which shall be followed strictly in order to conform to the standard.
Should: Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable.
PACKAGER: Company responsible for project, assembly, construction, fabrication, test and furnishing of the package.
MANUFACTURER: Company responsible by fabrication of equipment or component internal to the Package.
PACKAGE or **PACKAGE UNIT**: An assembly of equipment supplied interconnected, tested and operating, requiring only the available utilities from the Unit for the Package operation.
PURCHASER: The Company designated as such in the contract or the purchase order.

3.2 ABBREVIATIONS

PT	Liquid penetrant examination (also known as dye penetrant examination);
MP	Magnetic particle examination;
VE	Visual examination;
UT	Ultrasonic examination;
RT	Radiographic examination;
HD	Hardness examination;
PMI	Positive material identification;
HAZ	Heat-affected zone;
NDT	Non Destructive Testing

4 QUALITY REQUIREMENTS

MANUFACTURER must develop and implement a comprehensive quality system for fusion welding of metallic materials both in workshops and at field installation sites in accordance with ISO 3834-2.

Welding shall always be performed in accordance with the requirements of I-ET-3000.00-1200-955-P4X-001.

Personnel and procedure qualification for welding and for NDT shall be in accordance with I-ET-0000.00-0000-970-PSQ-001.

5 REQUIREMENTS FOR WELDING INSPECTION OF PIPING

5.1 INSPECTION – GENERAL REQUIREMENTS

5.1.1 The requirements listed below apply to piping systems designed by ASME B31.1 or ASME B31.3.

5.1.2 Before any nondestructive testing, all welded joints of the section released for testing must be visually inspected to assure that the surface conditions comply with the preparation requirement for the test, and to verify that the surface is free from defects.

5.1.3 The acceptance criteria of the tests shall be in accordance with ASME B31.1 or ASME B31.3 standard, as applicable.

5.1.4 When removing any temporary attachment welded to the pipe the surface must be grinded and tested by liquid penetrant or magnetic particle test.

5.1.5 Hammering shall not be used under any circumstances to remove temporary welded attachments.

5.1.6 Temporary attachments shall be completely and carefully removed prior to any postweld heat treatment and prior to the pressure test.

5.1.7 During visual inspection any discontinuity like welding spatter, slag, pore or arc strike must be grinded and tested by liquid penetrant or magnetic particle test.

5.2 INSPECTION CLASSES

5.2.1 Inspection Classes must be determined according to the Table 1. The classification system is based essentially on material chemical composition and line pressure classes (according ASME B16.5).

5.2.2 The Inspection Classes for the most common piping specs and its fluids are listed in Appendix A from this technical specification.

5.2.3 Cited fluid services and operation conditions "Category D Fluid Service", “Normal Fluid Service”, "Category M Fluid Service", "Severe Cyclic Service", “High Temperature Service” and "High Pressure Services" are defined in ASME B31.3.

5.2.4 Any combination of fluid and material that can be prone to stress corrosion cracking shall be inspected as Inspection Class IV.

5.2.5 Welds between dissimilar materials or different inspection classes shall be inspected as per the most stringent examination requirement (higher extent).

Table 1 – Inspection Classes for Piping

“Fluid Service” ASME B31.3 / Base Material (Note 1)		P-No	Pressure Class						High Pressure Service (Note 5)
			150#	300#	600#	900#	1500#	2500#	
Category D Fluid Service		All	I	---	---	---	---	---	---
Normal Fluid Service	Carbon Steel (Note 2)	1	II	II	II	II	IV	IV	IV
	Martensitic Stainless Steel (type 410)	6	II	II	II	II	IV	IV	IV
	Ferritic Stainless Steel (type 405)	7	II	II	II	II	IV	IV	IV
	Steel 3 ½ Ni	9B	II	II	II	II	IV	IV	IV
	Steel 9 Ni	11A-SG1	IV	IV	IV	IV	IV	IV	IV
	Austenitic Stainless Steel	8	II	II	II	II	IV	IV	IV
	Duplex/Superduplex Stainless Steel	10H	II	II	II	II	IV	IV	IV
	Nickel Alloys	41...45	II	II	II	II	IV	IV	IV
	Copper Alloys	31...35	II	II	---	---	---	---	---
	Lines with inflammable gases	All	II	II	IV	IV	IV	IV	IV
	Lines with Hydrogen Service (Note 3)	All	III	III	IV	IV	IV	IV	IV
High Temperature Service		All	IV	IV	IV	IV	IV	IV	---
Category M Fluid Service (Note 4)		All	IV	IV	IV	IV	IV	IV	---
Severe Cyclic Service		All	IV	IV	IV	IV	IV	IV	---
Non Metallic Piping		NA	V	V	---	---	---	---	---

NOTE 1 For unlisted materials adopt Inspection Class IV, unless otherwise approved by PETROBRAS.
NOTE 2 For H_2S service (as per ISO 15156-1/2/3) and for low temperature service (<-29ºC) adopt Inspection Class III for pressure classes 150# through 900#.
NOTE 3 Lines with any percentage of Hydrogen.
NOTE 4 Fluid can only be designated as Category M when approved by Petrobras.
NOTE 5 Lines that are designed according to Chapter IX of ASME B31.3

5.3 TYPE AND EXTENT OF NDT

5.3.1 The type and extent of the NDT examination for metallic piping shall be as determined in Table 2, depending upon the Inspection Class determined as per Table 1.

5.3.2 In addition to the NDT extent from Table 2, except for Category D fluid service all socket welds shall be 100% inspected by PT.

5.3.3 “In process examination” as defined in ASME B31.3 is not acceptable as a substitute for the NDT inspection requirements.

5.3.4 The type and extent of the NDT examination for non-metallic piping shall be as follows:

a) 100% Visual Test;

b) 5% RT/UT (to be executed at laminated and bonded joints);

c) 100% Hardness Test (according to ASTM D-2583);

d) 10% PMI

5.3.5 NDT procedures applicable to non-metallic materials shall be submitted to PETROBRAS approval.

5.4 SAMPLING

5.4.1 When sampling test is indicated (random examination) in Table 2 a percentage of the welds within the specified lot must be selected, and the whole weld length of any selected weld joint must be inspected.

5.4.2 A LOT is defined as the total number of joints welded during a period (not greater than three months), grouped by pipe standard or specification and by welder/welding operator.

5.4.3 Pipe shop welds (fabrication of spools) and on site welds (assembly of piping) shall be grouped in separated lots.

5.4.4 When samples are selected for examination, the work of all welders and welding operators shall be covered by the sample selection.

5.5 PENALTIES

5.5.1 Penalties (Progressive Sampling for Examination) shall be applied to the welder/weld operator responsible for the defective weld as stated in ASME B31.3.

5.5.2 The lot approval, replacement, repair and reexamination shall be as stated in ASME B31.3.

5.5.3 For each rejected joint due to reheating crack defect, two other joints shall be inspected. If any new joint inspected shows the same reheating crack defect, all welding with the same consumable shall be 100% inspected.

5.5.4 The selection of new joint to be radiographed shall be performed by the welding professional level 2 and approved by PETROBRAS’ inspection.

Table 2 - Type and extension of NDT

Class	"P-Number"	NDT	NDT EXTENT			
			Circumferential Welds (Note 2)	Branch Connections (Notes 1 and 2)	Fillet Welds (Note 3)	Pipe Supports (Note 4)
I	All	VT	100 %	100 %	100 %	100 %
II	1	VT	100 %	100 %	100 %	100 %
		RT	10 %	-	-	-
		UT (Note 5)	-	10 %	-	-
		MP	10%	10 %	10 %	10 %
		Hardness	According to Item 5.6			
	6, 7	VT	100 %	100 %	100 %	100 %
		RT	10 %	-	-	-
		UT (Note 5)	-	10 %	-	-
		MP	100 %	100 %	100 %	100 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
	8, 9B, 10H, 11A 41-45, 31-35	VT	100 %	100 %	100 %	100 %
		RT	10 %	-	-	-
		UT (Note 5)	-	10 %	-	-
		LP	10 %	10 %	10 %	10 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
III	1	VT	100 %	100 %	100 %	100 %
		RT	25 %	-	-	-
		UT (Note 5)	-	25 %	-	-
		MP	25%	25 %	25 %	25 %
		Hardness	According to Item 5.6			
	6, 7	VT	100 %	100 %	100 %	100 %
		RT	25 %	-	-	-
		UT (Note 5)	-	25 %	-	-
		MP	100 %	100 %	100 %	100 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
	8, 9B, 10H, 11A 41-45, 31-35	VT	100 %	100 %	100 %	100 %
		RT	25 %	-	-	-
		UT (Note 5)	-	25 %	-	-
		LP	25 %	25 %	25 %	25 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
IV	1	VT	100 %	100 %	100 %	100 %
		RT	100 %	-	-	-
		UT (Note 5)	-	100 %	-	-
		MP	100 %	100 %	100 %	100 %
		Hardness	According to Item 5.6			
	6, 7	VT	100 %	100 %	100 %	100 %
		RT	100 %	-	-	-
		UT (Note 5)	-	100 %	-	-
		MP	100 %	100 %	100 %	100 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
	8, 9B, 10H, 11A 41-45	VT	100 %	100 %	100 %	100 %
		RT	100 %	-	-	-
		UT (Note 5)	-	100 %	-	-
		LP	100 %	100 %	100 %	100 %
		Hardness	According to Item 5.6			
		PMI	According to Item 5.7			
V	GRP	VT	100 %	100 %	100 %	100 %
		RT/UT (Note 6)	-	5%	-	-
		Hardness (Note 7)	100%			
		PMI (Note 8)	10%			

Table Notes:

1) By branch connection welds subjected to NDT examinations, it means:
   a) Welds between the main pipe and reinforcing pad (when applied);
   b) Welds between branch pipe and reinforcing pad (when applied);
   c) Welds between main pipe and branch pipe;
   d) Welds between main pipe and forged fittings like couplings, half-couplings, branch connections like sockolets, weldolets and threadolets.
2) For fittings that have welds suitable to radiographic examination (see ASME B31.3, figure 328.5.4E: Acceptable Details for Branch Attachment Suitable for 100% Radiography); the welds must be tested as per the requirement for circumferential welds.
3) Fillet welds include, among others, socket welds, sealing welds, and seal weld of threaded connections and slip-on flanges welds.
4) Weld between support element and pipe surface. Remaining pipe support welds shall be examined as per Item 6 of this specification;
5) Valid for Note 1(c).
6) RT/UT to be executed at laminated and bonded joints;
7) 100% Hardness Test according to ASTM D2583;
8) PMI shall be applied by means of Near Infrared Spectroscopy (NIRS) in accordance with ASTM E1790

General Notes:

a) Ultrasonic test can be used instead of radiographic test, only with owner approval (Technical Query Form) and owner approval of the ultrasonic test procedure. For Class II and Class IV, the ultrasonic acceptance criteria of ASMEB 31.3 (344.6.2) shall be supplemented by following criteria: all crack, lack of fusion and lack of penetration are inacceptable independent of length and amplitude (based in criteria of the Table 341.3 for radiographic). When the welding material is anisotropic (for example: stainless steel, Inconel, nickel alloy) shall be demonstrated the performance of ultrasonic system in representative mockups.

b) If it is not possible to apply magnetic particle testing, liquid penetrant examination can be used on the same extent.

c) Visual Examination shall be performed also on the root side of the weld when accessible.

5.6 WELD HARDNESS MEASUREMENTS

5.6.1 After heat treatment, or when required by the Project, weld hardness must be measured.

5.6.2 When more than one pipe spool is heat treated in the same furnace, the number of tested weld joints is 10% of the total weld joints. The selected joints must include the thicker weld joints.

5.6.3 When only one spool is heat treated in the furnace, the number of tested weld joints is 10% of the total weld joints of this spool or one joint, whichever is greater. The selected joint(s) must include the thickest weld joint(s).

5.6.4 When weld joints are heat treated one by one, all joints must be inspected.

5.6.5 When hardness testing is required, it shall be performed according to standard ASTM A 1038. Hardness measurements can be done using portable (hand held) equipment and the MANUFACTURER must have a specific procedure for use those hand held equipment.

5.6.6 When using portable instrument, it shall be demonstrated the instrument suitability to testing performance, by comparison hardness measurements, in a welded joint of same material specification of equipment/component to be tested, made with portable equipment with measurements made with Vickers hardness testing machines according to ASTM E384. The test methodology shall be approved by PNBV.

5.6.7 Weld hardness must be measured as near as possible to the fusion line. The conceptual idea behind this statement is to evaluate the hardness of HAZ.

5.6.8 For dissimilar welds, both sides of weld must be tested.

5.7 PMI

5.7.1 The Positive Materials Identification (PMI) shall be carried out with equipment capable to identify the specified type of material in accordance with established procedure. The equipment shall not make burn marks to the pipe material.

5.7.2 The PMI shall be performed on the following moments:

a) prior to the welding, in order to properly identify the materials which will be welded/assembled [Recommended Practice];

b) after fabrication of the pipe spool is finished, testing for all base materials and welds (before releasing from the pipeshop);

c) after field joints are finished, checking all base materials not previously tested at pipe shop and all welds performed in the field;

d) in piping supports welded directly to the piping wall;

5.7.3 PMI shall be done according to API RP 578 standard.

6 REQUIREMENTS FOR WELDING INSPECTION OF METALLIC STRUCTURAL COMPONENTS

6.1 INSPECTION – GENERAL REQUIREMENTS

6.1.1 The inspection requirements herein listed are applicable to all and every structural component added to the unit with the intent of supporting the piping. This included the piping support itself (as detailed in the standard piping support catalogues), special piping supports (designed in order to withstand specific piping loads), as well as any others additional structural components which are directly connected to the hull or to the main structure of the modules.

6.1.2 The welded connection of the piping support directly to the piping wall must be inspected as stablished in Table 2 above (column for piping support elements).

6.1.3 The welded connection of the structural components to the hull or to the module main structure must be inspected as stablished in the inspection requirements for these main structures (hull and topside structure Technical Specifications contains these inspection requirements, which depends on the category of the structure).

6.1.4 The remaining welds of the structural components shall be inspected as indicated in this Technical Specification. Figure 2 illustrates the above mentioned inspection scope.

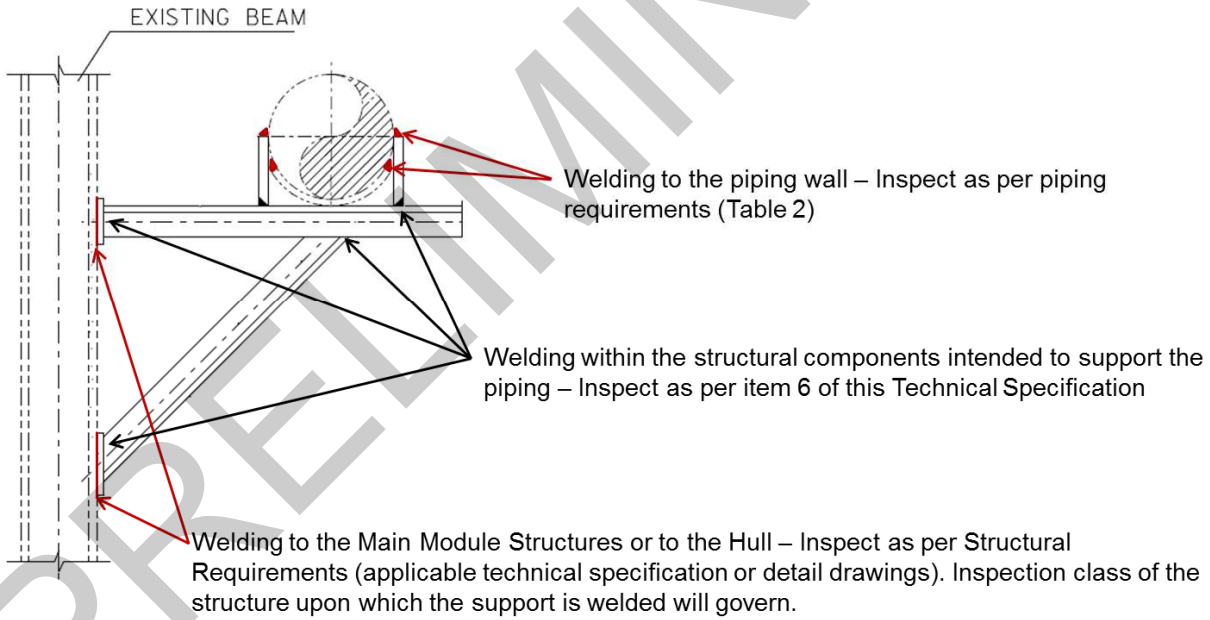

Figure 2 – Structural components inspection requirements

6.1.5 All structural components must be designed in accordance with AWS D1.1.

6.1.6 The surfaces of chamfers shall be smooth and uniform, with no deep grooves and shall be inspected in accordance with AWS D1.1.

6.1.7 A double plate shall always be added in between the structural supports and the hull, even when the support is not directly welded to the hull. Figures 3 and 4 illustrate typical details for the double plates.

6.1.8 The double plate minimum thickness and steel quality shall be the same as the main structural element to which it is connected.

6.1.9 Any weld connection to the hull or to the modules main structure has to be approved by the Structural Designer (maximum loads and relative position in relation to internal reinforcements need to be checked before welding commences). The same is applicable for penetration pieces that pierce through any hull plate or through any module structure element, which shall also be approved by the Structural Designer.

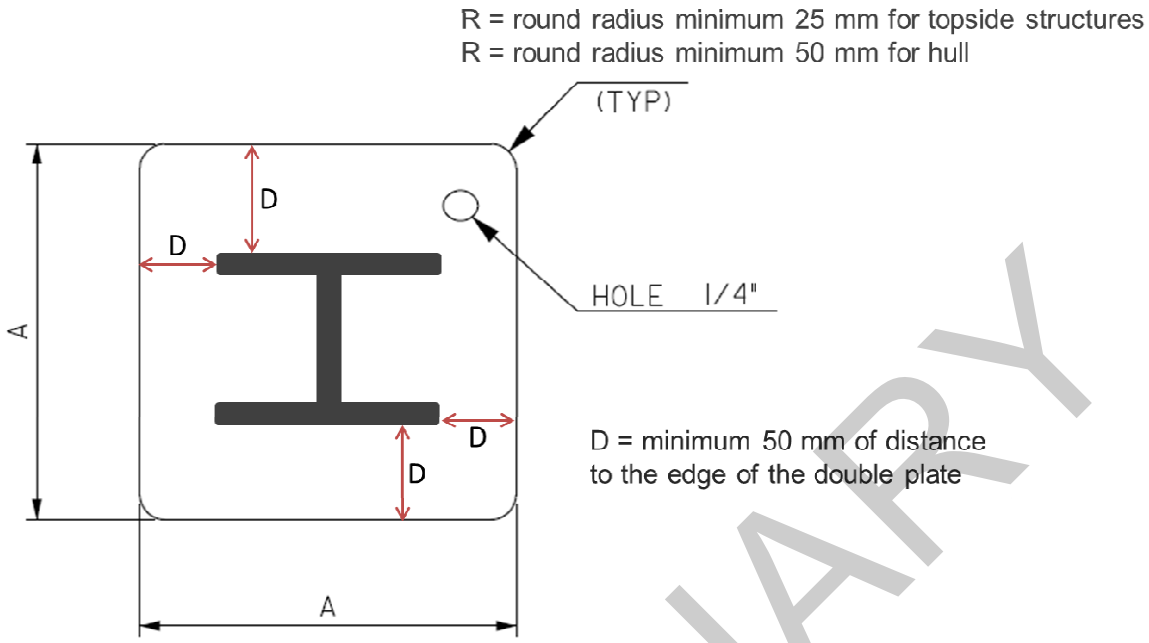

Figure 3 – Typical double plate to protect the hull from pipe support direct weld.
Dimension A will vary with support general dimensions.

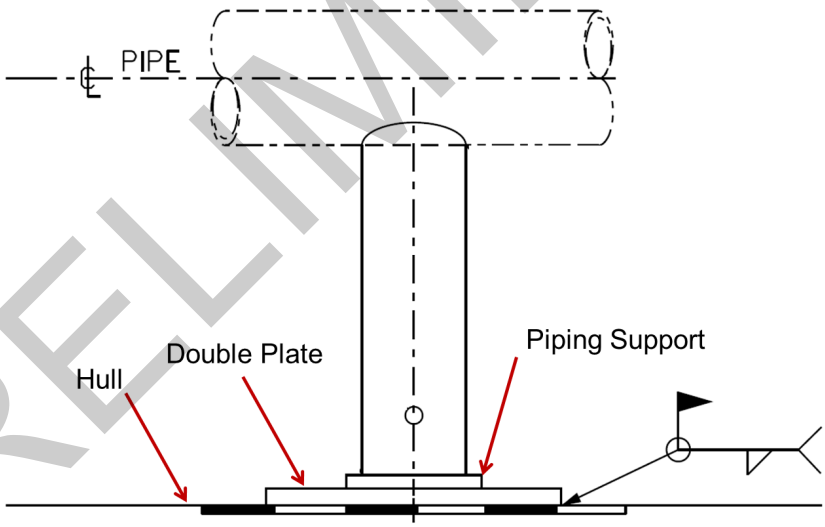

Figure 4 – Double plate shall be big enough to contain all the piping support elements (anchors, guides, shoes, and so on)

6.2 INSPECTION EXTENT

6.2.1 Weld inspection shall be performed in accordance with AWS D1.1, with the acceptance criteria for structures cyclically loaded.

6.2.2 The inspection extent shall be as defined in Table 3 below.

Table 3 – Inspection Extent for Pipe Supporting Structures

Joint	Inspection Method			
	Visual	MP	RT	UT
Full Penetration Butt Joint	100%	5%	5%	-
Full Penetration T Joint	100%	5%	-	5%
Partial Penetration T Joint	100%	5%	-	-

6.2.3 UT may be used in lieu of RT for thickness above 12mm. PT may be used in lieu of MP when access for MP won't allow inspection.

6.2.4 Where the table indicates a percentage for the weld inspection it means that all and every weld shall have this percentage of its length examined. This percentage must also include all welders and weld operators that contributed to the weld. For butt joints the percentage is applicable for both sides of the joint (when accessible). For T joints the percentage is also applicable for both sides of the joint.

6.2.5 When the inspection of a joint which was originally examined as a percentage of its length indicates a defect, two other regions of the same joint and with the same original length (and from the same welder when possible) shall also be investigated with the same inspection method.

a) If no defects are found in the new inspection lengths than the original inspected weld length can be repaired and the joint may be accepted;

b) If the new inspection lengths reveal any defect than the whole length of the weld must be examined and repaired accordingly.

APPENDIX A – INSPECTION CLASSES FOR MOST COMMOM PIPING SPECS

SPEC	PRESSURE CLASS	P-Number	SERVICE DESCRIPTION	INSPECTION CLASS	CRITERIA
A4	125	1	SFW - Fire Water (Fresh Water)	II (note 1)	(note 3)
A8	125	1	GW - Grey Water	I	(note 3)
A8	125	1	HWU - Utility Heating Water	II (note 1)	(note 3)
A8	125	1	SP - Vent and Tank sounding	II	(note 3)
A8	125	1	WW - Sewage Waste Water	I	(note 3)
B10	150	1	AM – Amine	II	(note 3)
B10	150	1	BG - Inert Gas	II (note 1)	(note 3)
B10	150	1	CHW - Chilled Water	II (note 1)	(note 3)
B10	150	1	CI - Chemical Injection (non-corrosive)	II	(note 3)
B10	150	1	D – Diesel	II	(note 3)
B10	150	1	DF - Closed Drain (Non-Corrosive hydrocarbon)	II	(note 3)
B10	150	1	F - Safety System and Flare	II	(note 3)
B10	150	1	FG - Combustible Gas	II	(note 3)
B10	150	1	FL - Foam Line	II (note 1)	(note 3)
B10	150	1	G - Glycol	II	(note 3)
B10	150	1	OL - Lubrificating Oil	II (note 1)	(note 3)
B10	150	1	P - Process (non-corrosive hydrocarbon)	II	(note 3)
B10	150	1	SA - Service Compressed Air (utility Air)	II (note 1)	(note 3)
B10	150	1	SN - Start-up Nitrogen	II (note 1)	(note 3)
B10	150	1	W - Industrial water	II (note 1)	(note 3)
B11	150	1	ADW - Aerated Dilution Water	II (note 1)	(note 3)
B11	150	1	IW - De-Aerated Sea Water Injection	II (note 1)	(note 3)
B11	150	1	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B11	150	1	PCW - Produced water	II (note 1)	(note 3)
B12	150	10H	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B14	150	1	BW - Ballast	II (note 1)	(note 3)
B14	150	1	CN - Sodium Hypochlorite	II	(note 3)
B14	150	1	IW - De-Aerated Sea Water Injection	II (note 1)	(note 3)
B14	150	1	IWC - Aerated Sea Water Injection	II (note 1)	(note 3)
B14	150	1	SW - Aerated Sea Water	II (note 1)	(note 3)
B16	150	10H	AM - Amine	II	(note 3)
B16	150	10H	F - Safety System and Flare	II	(note 3)
B16	150	10H	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B17	150	1	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B19	150	1	F - Safety System and Flare	II	(note 3)
B20	-	-	CHW - Chilled Water	-	-
B20	-	-	CN - Sodium Hypochlorite	-	-
B20	-	-	GW - Grey Water	-	-
B20	-	-	PW - Potable Water	-	-
B20	-	-	W - Industrial water	-	-
B20	-	-	WW - Sewage Waste Water	-	-
B21	-	-	HWU - Utility Heating Water	-	-
B21	-	-	PWH - Hot Fresh Water	-	-
B22	-	GRP	DA - Open Drain	V (note1)	(nota 6)
B22	-	GRP	GW - Grey Water	V (note1)	(nota 6)
B22	-	GRP	HWU - Utility Heating Water	V (note1)	(nota 6)
B22	-	GRP	IWC - Aerated Sea Water Injection	V (note1)	(nota 6)
B22	-	GRP	PCW - Produced water	V (note1)	(nota 6)
B22	-	GRP	PWH - Hot Fresh Water	V (note1)	(nota 6)
B22	-	GRP	SW - Aerated Sea Water	V (note1)	(nota 6)
B22	-	GRP	W - Industrial water	V (note1)	(nota 6)
B22	-	GRP	WW - Sewage Waste Water	V (note1)	(nota 6)
B23	-	GRP	GW - Grey Water	V (note1)	(nota 6)
B23	-	GRP	HWU - Utility Heating Water	V (note1)	(nota 6)
B23	-	GRP	PCW - Produced water	V (note1)	(nota 6)
B23	-	GRP	PWH - Hot Fresh Water	V (note1)	(nota 6)
B23	-	GRP	SW - Aerated Sea Water	V (note1)	(nota 6)
B23	-	GRP	W - Industrial water	V (note1)	(nota 6)
B23	-	GRP	WW - Sewage Waste Water	V (note1)	(nota 6)
B24	-	GRP	FW - Fire Water (Sea Water)	V (note1)	(nota 6)
B25	-	GRP	DA - Open Drain	V (note1)	(nota 6)
B25	-	GRP	PCW - Produced water	V (note1)	(nota 6)
B26	-	GRP	FW - Fire Water (Sea Water)	V (note1)	(nota 6)
B27	-	GRP	FW - Fire Water (Sea Water)	V (note1)	(nota 6)
B3	150	8	AM - Amine	II	(note 3)
B3	150	8	BG - Inert Gas	II (note 1)	(note 3)
B3	150	8	CNI - Corrosive Chemical Injection	II	(note 3)

B3	150	8	D - Diesel	II	(note 3)
B3	150	8	DW - Distilled Water	II (note 1)	(note 3)
B3	150	8	F - Safety System and Flare	II	(note 3)
B3	150	8	FG - Combustible Gas	II	(note 3)
B3	150	8	H - Hydraulic Fluid	II	(note 3)
B3	150	8	IA - Instrumentation Air	II (note 1)	(note 3)
B3	150	8	IG - Instrumentation Gas	II	(note 3)
B3	150	8	IGN - Ignition Line	II	(note 3)
B3	150	8	IN - Instrumentation Nitrogen	II (note 1)	(note 3)
B3	150	8	JF - Aviation Kerosene	II	(note 3)
B3	150	8	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B3	150	8	PW - Potable Water	II (note 1)	(note 3)
B3	150	8	PWH - Hot Fresh Water	II (note 1)	(note 3)
B3	150	8	SP - Vent and Tank sounding	II	(note 3)
B30	150	43	F - Safety System and Flare	II	(note 3)
B4	150	1	HF - Hot Fluid	II (note 1)	(note 3)
B4	150	1	HWP - Process Heating Water	II (note 1)	(note 3)
B4	150	1	S - Steam	II	(note 3)
B4	150	1	SC - Steam Condensate	II (note 1)	(note 3)
B5	150	1	FP-Production and Drilling Fluid	II (note 1)	(note 3)
B6	150	1	F - Safety System and Flare	II	(note 3)
B6	150	1	G - Glycol	II	(note 3)
B6	150	1	GL - Refrigerated Liquified Petroleum Gas	II	(note 3)
B6	150	1	P - Process (non-corrosive hydrocarbon)	II	(note 3)
B6C	150	1	SW - Aerated Sea Water	II (note 1)	(note 3)
B7	20 BAR	34	FW - Fire Water (Sea Water)	II (note 1)	(note 3)
B7R	16 BAR	34	BR - Bilge	II	(note 3)
B7R	17 BAR	34	FL - Foam Line	II (note 1)	(note 3)
B7R	18 BAR	34	FW - Fire Water (Sea Water)	II (note 1)	(note 3)
B7R	19 BAR	34	SW - Aerated Sea Water	II (note 1)	(note 3)
B9	150	1	AM - Amine	II	(note 3)
B9	150	1	DA - Open Drain	I	(note 3)
B9	150	1	DFC - Closed Drain (Corrosive Hydrocarbon)	II	(note 3)
B9	150	1	F - Safety System and Flare	II	(note 3)
B9	150	1	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
B9	150	1	PCW - Produced water	II (note 1)	(note 3)
B9	150	1	SP - Vent and Tank sounding	II	(note 3)
C10	300	1	AM - Amine	II	(note 3)
C10	300	1	CI - Chemical Injection (non-corrosive)	II	(note 3)
C10	300	1	D - Diesel	II	(note 3)
C10	300	1	FG - Combustible Gas	II	(note 3)
C10	300	1	G - Glycol	II	(note 3)
C10	300	1	IW - De-Aerated Sea Water Injection	II	(note 3)
C10	300	1	P - Process (non-corrosive hydrocarbon)	II	(note 3)
C10	300	1	SA - Service Compressed Air (utility Air)	II	(note 3)
C10	300	1	SN - Start-up Nitrogen	II	(note 3)
C10	300	1	W - Industrial water	II	(note 3)
C10P	300	1	P - Process (non-corrosive hydrocarbon)	II	(note 5)
C11	300	1	PCW - Produced water	II	(note 3)
C12	300	10H	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
C14	300	1	IW - De-Aerated Sea Water Injection	II	(note 3)
C14	300	1	SW - Aerated Sea Water	II	(note 3)
C16	300	10H	AM - Amine	II	(note 3)
C16	300	10H	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
C3	300	8	CNI - Corrosive Chemical Injection	II	(note 3)
C3	300	8	D - Diesel	II	(note 3)
C3	300	8	FG - Combustible Gas	II	(note 3)
C3	300	8	H - Hydraulic Fluid	II	(note 3)
C3	300	8	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
C30	300	43	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
C4	300	1	HF - Hot Fluid	II (note 1)	(note 3)
C4	300	1	HWP - Process Heating Water	II (note 1)	(note 3)
C4	300	1	S - Steam	II	(note 3)
C4	300	1	SC - Steam Condensate	II	(note 3)
C5	300	1	FP-Production and Drilling Fluid	II	(note 3)
C6	300	1	F - Safety System and Flare	II	(note 3)
C6	300	1	G - Glycol	II	(note 3)
C6	300	1	GL - Refrigerated Liquified Petroleum Gas	II	(note 3)
C6	300	1	P - Process (non-corrosive hydrocarbon)	II	(note 3)
C8	300	1	DO - Carbon Dioxide (DRY)	II	(note 3)
C9	300	1	PC - Process (Corrosive Hydrocarbon)	II	(note 3)
E10	600	1	AM - Amine	II	(note 3)
E10	600	1	BG - Inert Gas	II	(note 3)

E10	600	1	CI - Chemical Injection (non-corrosive)	II	(note 3)
E10	600	1	FG - Combustible Gas	IV	(note 3)
E10	600	1	G - Glycol	II	(note 3)
E10	600	1	IW - De-Aerated Sea Water Injection	II	(note 3)
E10	600	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
E10	600	1	W - Industrial water	II	(note 3)
E10R	600	1	W - Industrial water	II	(note 3)
E11	600	1	PCW - Produced water	II	(note 3)
E14	600	1	IW - De-Aerated Sea Water Injection	II	(note 3)
E16	600	10H	AM - Amine	II	(note 3)
E16	600	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
E17	600	1	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
E3	600	8	AM - Amine	II	(note 3)
E3	600	8	CNI - Corrosive Chemical Injection	II	(note 3)
E3	600	8	D - Diesel	II	(note 3)
E3	600	8	FG - Combustible Gas	IV	(note 3)
E3	600	8	H - Hydraulic Fluid	II	(note 3)
E3	600	8	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
E30	600	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
E32	600	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
E4	600	1	HWP - Process Heating Water	II (note 1)	(note 3)
E4	600	1	S - Steam	II	(note 3)
E4	600	1	SC - Steam Condensate	II	(note 3)
E5	600	1	FP-Production and Drilling Fluid	II	(note 3)
E6	600	1	G - Glycol	II	(note 3)
E6	600	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
E6	600	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
E6R	600	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
E8	600	1	DO - Carbon Dioxide (DRY)	II	(note 3)
E9	600	1	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
F10	900	1	BG - Inert Gas	II	(note 3)
F10	900	1	CI - Chemical Injection (non-corrosive)	II	(note 3)
F10	900	1	FG - Combustible Gas	IV	(note 3)
F10	900	1	G - Glycol	II	(note 3)
F10	900	1	HWU - Utility Heating Water	II	(note 3)
F10	900	1	IW - De-Aerated Sea Water Injection	II	(note 3)
F10	900	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
F10	900	1	W - Industrial water	II	(note 3)
F10P	900	1	P - Process (non-corrosive hydrocarbon)	IV	(note 5)
F10R	900	1	BG - Inert Gas	II	(note 3)
F10R	900	1	CI - Chemical Injection (non-corrosive)	II	(note 3)
F10R	900	1	G - Glycol	II	(note 3)
F10R	900	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
F10R	900	1	W - Industrial water	II	(note 3)
F11	900	1	PCW - Produced water	II	(note 3)
F14	900	1	IW - De-Aerated Sea Water Injection	II	(note 3)
F16	900	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
F3	900	8	CNI - Corrosive Chemical Injection	II	(note 3)
F3	900	8	D - Diesel	II	(note 3)
F3	900	8	FG - Combustible Gas	IV	(note 3)
F3	900	8	H - Hydraulic Fluid	II	(note 3)
F3	900	8	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
F30	900	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
F32	900	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
F4	900	1	S - Steam	II	(note 3)
F4	900	1	SC - Steam Condensate	II	(note 3)
F5	900	1	FP-Production and Drilling Fluid	II	(note 3)
F6	900	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
F6	900	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
F6R	900	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
F6R	900	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
G10	1500	1	BG - Inert Gas	IV	(note 3)
G10	1500	1	CI - Chemical Injection (non-corrosive)	IV	(note 3)
G10	1500	1	G - Glycol	IV	(note 3)
G10	1500	1	IW - De-Aerated Sea Water Injection	IV	(note 3)
G10	1500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
G10	1500	1	W - Industrial water	IV	(note 3)
G10P	1500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 5)
G10R	1500	1	BG - Inert Gas	IV	(note 3)
G10R	1500	1	CI - Chemical Injection (non-corrosive)	IV	(note 3)
G10R	1500	1	G - Glycol	IV	(note 3)
G10R	1500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
G10R	1500	1	W - Industrial water	IV	(note 3)

G11	1500	1	PCW - Produced water	IV	(note 3)
G12	1500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
G12P	1500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 5)
G14	1500	1	IW - De-Aerated Sea Water Injection	IV	(note 3)
G16	1500	10H	DFC - Closed Drain (Corrosive Hydrocarbon)	IV	(note 3)
G16	1500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
G16P	1500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 5)
G19	1500	1	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
G3	1500	8	CNI - Corrosive Chemical Injection	IV	(note 3)
G3	1500	8	D - Diesel	IV	(note 3)
G3	1500	8	FG - Combustible Gas	IV	(note 3)
G3	1500	8	G - Glycol	IV	(note 3)
G3	1500	8	H - Hydraulic Fluid	IV	(note 3)
G3	1500	8	IA - Instrumentation Air	IV	(note 3)
G3	1500	8	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
G3	1500	8	PC - Process (Corrosive Hydrocarbon)	IV	(note 3)
G4	1500	1	S - Steam	IV	(note 3)
G4	1500	1	SC - Steam Condensate	IV	(note 3)
G5	1500	1	FP-Production and Drilling Fluid	IV	(note 3)
G6	1500	1	G - Glycol	IV	(note 3)
G6	1500	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
G6	1500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
G6R	1500	1	GL - Refrigerated Liquified Petroleum Gas	IV	(note 3)
G6R	1500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 3)
H10	2500	1	D - Diesel	IV	(note 4)
H10	2500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
H10P	2500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 5)
H11	2500	1	PCW - Produced water	IV	(note 4)
H12	2500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
H12P	2500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 5)
H16	2500	10H	CNI - Corrosive Chemical Injection	IV	(note 4)
H16	2500	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
H3	2500	8	CNI - Corrosive Chemical Injection	IV	(note 4)
H3	2500	8	H - Hydraulic Fluid	IV	(note 4)
H3	2500	8	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
H30	2500	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
H30P	2500	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 5)
H31	2500	11A	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
H31	2500	11A	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
H33	2500	43	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
H5	2500	1	FP-Production and Drilling Fluid	IV	(note 4)
H6	2500	1	G - Glycol	IV	(note 4)
H6	2500	1	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
J12	10000	10H	CNI - Corrosive Chemical Injection	IV	(note 4)
J12	10000	10H	PC - Process (Corrosive Hydrocarbon)	IV	(note 4)
J31	10000	11A	DOH - Carbon Dioxide w/ Hydrocarbon	IV	(note 4)
J31	10000	11A	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
J31P	10000	11A	DOH - Carbon Dioxide w/ Hydrocarbon	IV	(note 5)
J31P	10000	11A	P - Process (non-corrosive hydrocarbon)	IV	(note 5)
J40	10000	43	P - Process (non-corrosive hydrocarbon)	IV	(note 4)
J5	10000	1	FP-Production and Drilling Fluid	IV	(note 4)
S3	-	8	BG - Inert Gas	-	-
S3	-	8	CNI - Corrosive Chemical Injection	-	-
S3	-	8	DW - Distilled Water	-	-
S3	-	8	H - Hydraulic Fluid	-	-
S3	-	8	IA - Instrumentation Air	-	-
S3	-	8	IN - Instrumentation Nitrogen	-	-
S3	-	8	PW - Potable Water	-	-
S3	-	8	PWH - Hot Fresh Water	-	-
S3	-	8	SP - Vent and Tank sounding	-	-
S7	-	34	FW - Fire Water (Sea Water)	-	-
S9	-	1	AM - Amine	-	-
S9	-	1	DA - Open Drain	-	-
S9	-	1	DFC - Closed Drain (Corrosive Hydrocarbon)	-	-
S9	-	1	F - Safety System and Flare	-	-
S9	-	1	PC - Process (Corrosive Hydrocarbon)	-	-
T3	5000	8	CI - Chemical Injection (non-corrosive)	(note2)	(note 3)
T3	5000	8	CNI - Corrosive Chemical Injection	(note2)	(note 3)

Notes:

1 – Class I, if the design pressure does not exceed 10,35 bar(g) and the design temperature is not greater than 186°C.
2 – Class IV, if welding fittings were applied.
3 – Acceptance Criteria according to ASME B31.3 table 341.3.2 - item “Normal and Category M Fluid Service”.
4 – Acceptance Criteria according to ASME B31.3 table 341.3.2 - item “Severe Cyclic Conditions”.
5 – Acceptance Criteria according to API 1104.
6 – Acceptance Criteria according to ISO 14692-4 Annex A.