

PETRONAS TECHNICAL STANDARDS

TECHNICAL SPECIFICATION

FIELD WELDING OF DUPLEX AND SUPER DUPLEX STAINLESS STEEL PIPELINES (AMENDMENTS/SUPPLIMENTS TO API 1104)

PTS 61.40.20.31

DECEMBER 2011



© 2010 PETROLIAM NASIONAL BERHAD (PETRONAS)

All rights reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without the permission of the copyright owner

PTS Circular 2011 - 1



PTS No:	61.40.20.31
PTS Title:	FIELD WELDING OF DUPLEX AND SUPER DUPLEX STAINLESS STEEL PIPELINES (AMENDMENTS/SUPPLIMENTS TO API 1104)

This revision of PTS **61.40.20.31** – FIELD WELDING OF DUPLEX AND SUPER DUPLEX STAINLESS STEEL PIPELINES (AMENDMENTS/SUPPLIMENTS TO API 1104) (**December 2011, Revision 2**) has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in italic font.

The previous version of this PTS **61.40.20.31 (July 1999)** will be removed from PTS binder / e-repository from herein onwards.

The custodian of this PTS is:

Name : Hasbullah Abu Hassan

Tel. No : 603 – 2783 6501

Please direct any questions regarding this PTS to the above-named.

Document Approval

	Name	Designation	Date	Signature
Prepared	Noor Syamiza A Malik	Engineer (Materials)	2/12/2011	
	Nurul Hana Kamaruzaman	Engineer (Materials)	7/12/2011	
Reviewed	Hasbullah Abu Hassan	Custodian (Materials)	2/12/11	
Approved	Zamaluddin Ali	Custodian (Inspection)	16/12/11	
Verified	Che Wan Ibrahim Che Wan Sudin	Senior Manager Materials, Corrosion & Inspection	19/12/11	
Verified	Saifol Mualim Ahmad Yahaya	General Manager Engineering, GTS	22/12/11	
Endorsed	Pau Kiew Huai	Senior General Manager, GTS	28.12.11	

Revision History

Rev No.	Reviewed by	Approved by	Date
1	Noor Syamiza A Malik Nurul Hana Bt Kamaruzaman Hasbullah Abu Hassan	Zamaluddin Ali	

REVIEW COMMITTEE ACKNOWLEDGEMENT

This PTS has been prepared with the contribution of the following team members:

No	Name	Designation	Company
1.	Hasbullah B Abu Hassan	Custodian, Materials	GTS
2.	Ghazali B M Zin	Manager, Materials	DEMC/DD/PCSB
3.	Anuwar B A Wahab	Principal Engineer, Pipeline	DEPL/DD/PCSB
4.	Johari B Muhidin	Sr Materials Engineer	DEMC/DD/PCSB
5.	Siti Khadijah Bt Md Rawi	Materials Engineer	DEMC/DD/PCSB
6.	Noor Syamiza Abdul Malik	Materials Engineer	GTS
7.	Nurul Hana Bt Kamaruzzaman	Materials Engineer	GTS
8.	M Shahrizal B PKM Seeni Mohd	Materials Engineer	GTS
9.	Syahrizad Bt Mohd Yunus	Materials Engineer	GTS

PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/Divisions.

They are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU in oil and gas production facilities or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTSs may not cover every requirement or diversity of condition at each locality. The system of PTSs is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTSs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use PTS, they shall be solely responsible for such use, including the quality of their work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will typically expect them to follow those design and engineering practices that will achieve at least the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use PTS rests with three categories of users:

- 1) PETRONAS and its affiliates
- 2) Other parties who are authorised to use PTS subject to appropriate contractual arrangements
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, PETRONAS disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any PTS, combination of PTS or any part thereof. The benefit of this disclaimer shall inure in all respects to PETRONAS and/or any company affiliated to PETRONAS that may issue PTS or require the use of PTS.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, PTS shall not, without the prior written consent of PETRONAS, be disclosed by users to any company or person whomsoever and the PTS shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of PETRONAS. The copyright of PYS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PTS may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

TABLE OF CONTENTS

PART I	INTRODUCTION	7
1.1	SCOPE	7
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	7
1.3	DEFINITIONS	7
1.4	ABBREVIATIONS	8
1.5	CROSS-REFERENCES	9
1.6	UNITS	9
1.7	SUMMARY OF CHANGES	10
PART II	AMENDMENTS/SUPPLEMENTS TO API 1104 (Twentieth edition, October 2005 with Errata/Addendum of July 2007 and December 2008)	19
SECTION 1	GENERAL	19
1.1	SCOPE	19
SECTION 2	REFERENCED PUBLICATIONS	19
SECTION 3	DEFINITION OF TERMS	19
3.2	DEFINITIONS	19
SECTION 4	SPECIFICATIONS.....	20
4.1	EQUIPMENT	20
4.2	MATERIALS.....	20
4.3	QUALITY SYSTEM	21
SECTION 5	QUALIFICATION OF WELDING PROCEDURES FOR WELDS CONTAINING FILLER METAL ADDITIVES.....	22
5.1	PROCEDURE QUALIFICATION.....	22
5.2	RECORD	22
5.3	PROCEDURE SPECIFICATION	23
5.4	ESSENTIAL VARIABLES	25
5.5	WELDING OF TEST JOINTS – BUTT WELDS	26
5.6	TESTING OF WELDED JOINTS - BUTT WELDS	26
5.7	WELDING OF TEST JOINTS - FILLET WELDS	28
5.8	TESTING OF WELDED JOINTS – FILLET WELDS.....	29
5.9	WELDING OF TEST REPAIR WELDS	29
5.10	TESTING OF REPAIR WELDS.....	29
SECTION 6	QUALIFICATION OF WELDERS.....	30
6.1	GENERAL	30
6.2	SINGLE QUALIFICATION	30
6.3	MULTIPLE QUALIFICATION.....	30
6.4	VISUAL EXAMINATION.....	30
6.5	DESTRUCTIVE TESTING	30
6.6	RADIOGRAPHY – BUTT WELDS ONLY	31
6.7	RETESTING	31
6.8	RECORDS.....	32
SECTION 7	DESIGN AND PREPARATION OF A JOINT FOR PRODUCTION WELDING	32
7.1	GENERAL	32
7.2	ALIGNMENT	32
7.3	USE OF LINE-UP CLAMP FOR BUTT WELDS	33
7.4	BEVEL.....	33
7.7	CLEANING BETWEEN BEADS.....	33
7.8	POSITION WELDING.....	33
7.9	ROLL WELDING	33
7.10	IDENTIFICATION OF WELDS	34
7.11	PRE- AND POST-HEAT TREATMENT.....	34
7.12	SEPARATION OF GIRTH WELDS	34
7.13	PARTIALLY COMPLETED JOINTS	34
7.14	WELD FINISHING	34
7.15	SHIELDING AND BACKING GAS	34
SECTION 8	INSPECTION AND TESTING OF PRODUCTION WELDS.....	35
8.2	METHODS OF INSPECTION	35
8.3	QUALIFICATION OF INSPECTION PERSONNEL	35

8.4	CERTIFICATION OF NON-DESTRUCTIVE TESTING PERSONNEL	35
8.5	EXTENT OF INSPECTION AND TESTING	35
SECTION 9	ACCEPTANCE STANDARDS FOR NON-DESTRUCTIVE TESTING	36
9.1	GENERAL	36
9.3	RADIOGRAPHIC TESTING	36
9.4	MAGNETIC PARTICLE TESTING	37
9.5	LIQUID-PENETRANT TESTING	37
9.6	ULTRASONIC TESTING	37
SECTION 10	REPAIR AND REMOVAL OF DEFECTS	38
10.1	AUTHORIZATION FOR REPAIR	38
10.2	REPAIR PROCEDURE	38
SECTION 11	PROCEDURES FOR NON-DESTRUCTIVE TESTING	39
11.1	RADIOGRAPHIC TEST METHODS	39
11.2	MAGNETIC PARTICLE TEST METHOD	40
11.4	ULTRASONIC TEST METHOD	40
SECTION 12	MECHANIZED WELDING WITH FILLER METAL ADDITIONS	40
SECTION 13	AUTOMATIC WELDING WITHOUT FILLER-METAL ADDITIONS	41
SECTION 14	DOCUMENTATION	41
14.1	GENERAL	41
14.2	PRE-WELDING DOCUMENTATION	41
14.3	FINAL DOCUMENTATION	41
APPD. A	ALTERNATIVE ACCEPTANCE STANDARDS FOR GIRTH WELDS	42
A.1	GENERAL	42
PART III	REFERENCES	45

APPENDICES

APPENDIX 1	EXAMPLE OF USING RUN OUT LENGTH (ROL) TO MONITOR SHIELDED MANUAL ARC WELDING	48
APPENDIX 2	CORROSION TESTS FOR WELDING PROCEDURE QUALIFICATION	49
APPENDIX 3	DETERMINATION OF THE VOLUME FRACTION OF FERRITE IN DUPLEX STAINLESS STEEL BY SYSTEMATIC POINT COUNT	54

PART I INTRODUCTION

1.1 SCOPE

This PTS specifies the requirements and gives recommendations for field welding in the construction and maintenance of duplex and super duplex stainless steel pipelines for use in oil and gas operations under both sour and non-sour service conditions. The intended limits of application are as defined for pipeline scope boundaries in Figure 1 of PTS 31.40.00.10.

Welding on pressurised pipelines and hyperbaric welding are excluded from the scope of this PTS.

This PTS is based on API Std 1104, twentieth edition (November 2005) plus Errata/Addendum (July 2007) and Errata 2 (December 2008) and DEP February 2011:61.40.20.31.

Part II of this PTS gives amendments and supplements to the API Std 1104 in the form of replacements or additions to specific clauses and paragraphs. Clauses and paragraphs of API Std 1104 which are not amended by this PTS shall remain applicable as written. Tables or supplementary to those of API Std 1104, have been referred to using a capital letter, e.g. Table A, Figure B.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them.

This PTS is primarily intended to be used for oil and/or gas pipelines and related facilities. It is intended for use by Exploration and Production, Manufacturing, Chemicals or Supply/Marketing companies which require the use of line pipe.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regard to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the objective of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The Contractor is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or inspection operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The Manufacturer/Supplier is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The Principal is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicate a requirement.

The capitalised term **SHALL** indicate a process safety requirement.

The word **should** indicate a recommendation.

1.3.2 Specific definitions

Company	Term used in API 1104 which shall be understood to mean Principal.
Defect (in NDT)	An imperfection or group of imperfections whose indication do not meet specified acceptance criteria.
Elongated slag inclusion (ESI)	Term used in API 1104 which shall be understood to mean linear slag inclusion (reference 3011) as defined in ISO 6520.
Imperfection (in NDT)	An interruption, which may be either intentional or unintentional, in the physical structure or configuration of a pipe or weld.
Indication (in NDT)	Evidence of an imperfection that requires interpretation to determine its significance.
Penetrameter	Term used in API 1104 which shall be taken to mean IQI as used in ISO 17636.
Sour service	As defined in PTS 31.22.20.31.

1.4 ABBREVIATIONS

AC	Alternating Current
AI	Accumulated Imperfections
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AUT	Automatic Ultrasonic Testing
AWS	American Welding Society
BGAS	British Gas Approval Scheme
BT	Burn Through
C	Crack
CP	Cluster Porosity
CSWIP	Certification Scheme for Weld Inspection Personnel
CTOD	Crack Tip Opening Displacement
CRT	Computerized RT
D	Nominal Diameter
DC	Direct Current
DWE	Double Wall Exposure
DWV	Double Wall Viewing
ESI	Elongated Slag Inclusion
EU	Undercutting adjacent to the cover pass
FCAW	Flux Cored Arc Welding
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat-Affected Zone
IC	Internal Concavity

ICP	Inadequate Cross Penetration
IQI	Image Quality Indicator
ISI	Isolated Slag Inclusion
IU	Undercutting adjacent to the root pass
JKP	Jabatan Pembangunan Kemahiran (Department of Skills Development)
LB	Linear Buried (Indication)
LPTA	Lembaga Perlesenan Tenaga Atom (Atomic Energy Licensing Board)
LS	Linear Surface (Indication)
NDT	Non-Destructive Testing
NPS	Nominal Pipe Size
OD	Outside Diameter
PRE	Pitting Resistance Equivalent
PT	Liquid Penetrant Testing
PWHT	Post-Weld Heat Treatment
pWPS	Preliminary Welding Procedure Specification which is not qualified
ROL	Run Out Length
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
SWE	Single Wall Exposure
SWV	Single Wall Viewing
SSCC	Sulphide Stress Corrosion Cracking
T	Transverse (indication)
TCG	Time Corrected Gain
UT	Ultrasonic Testing
VC	Volumetric Cluster
VI	Volumetric Individual
WPS	Welding Procedure Specification
WPQR	Welding Procedure Qualification Record

1.5 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in (Part III). Cross-references to parts of API 1104 give section numbers without brackets.

1.6 UNITS

For simplicity, the common industry practice of indicating nominal pipe diameters in inches has been followed. For other dimensions, SI units have been used.

1.7 SUMMARY OF CHANGES

The previous edition of this PTS was dated July 1999. Other than editorial revisions, the following are the main changes to this document:

Old section	New Section	Change																																
1.1	1.1	Add the following: This PTS is based on API Std 1104, twentieth edition (November 2005) plus Errata/Addendum (July 2007) and Errata 2 (December 2008) and DEP February 2011:61.40.20.31. Part II of this PTS gives amendments and supplements to the API Std 1104 in the form of replacements or additions to specific clauses and paragraphs. Clauses and paragraphs of API Std 1104 which are not amended by this PTS shall remain applicable as written. Tables or supplementary to those of API Std 1104, have been referred to using a capital letter, e.g. Table A, Figure B.																																
1.2	1.2	Add the following: Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them.																																
1.3.1	1.3.1	Add the following: The Contractor is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or inspection operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.																																
1.4	1.4	Add the following: <table><tr><td>AC</td><td>Alternating Current</td></tr><tr><td>AI</td><td>Accumulated Imperfections</td></tr><tr><td>AUT</td><td>Automatic Ultrasonic Testing</td></tr><tr><td>BT</td><td>Burn Through</td></tr><tr><td>C</td><td>Crack</td></tr><tr><td>CP</td><td>Cluster Porosity</td></tr><tr><td>CTOD</td><td>Crack Tip Opening Displacement</td></tr><tr><td>CRT</td><td>Computerized RT</td></tr><tr><td>DC</td><td>Direct Current</td></tr><tr><td>DWE</td><td>Double Wall Exposure</td></tr><tr><td>DWV</td><td>Double Wall Viewing</td></tr><tr><td>ESI</td><td>Elongated Slag Inclusion</td></tr><tr><td>EU</td><td>Undercutting adjacent to the cover pass</td></tr><tr><td>FCAW</td><td>Flux Cored Arc Welding</td></tr><tr><td>IC</td><td>Internal Concavity</td></tr><tr><td>ICP</td><td>Inadequate Cross Penetration</td></tr></table>	AC	Alternating Current	AI	Accumulated Imperfections	AUT	Automatic Ultrasonic Testing	BT	Burn Through	C	Crack	CP	Cluster Porosity	CTOD	Crack Tip Opening Displacement	CRT	Computerized RT	DC	Direct Current	DWE	Double Wall Exposure	DWV	Double Wall Viewing	ESI	Elongated Slag Inclusion	EU	Undercutting adjacent to the cover pass	FCAW	Flux Cored Arc Welding	IC	Internal Concavity	ICP	Inadequate Cross Penetration
AC	Alternating Current																																	
AI	Accumulated Imperfections																																	
AUT	Automatic Ultrasonic Testing																																	
BT	Burn Through																																	
C	Crack																																	
CP	Cluster Porosity																																	
CTOD	Crack Tip Opening Displacement																																	
CRT	Computerized RT																																	
DC	Direct Current																																	
DWE	Double Wall Exposure																																	
DWV	Double Wall Viewing																																	
ESI	Elongated Slag Inclusion																																	
EU	Undercutting adjacent to the cover pass																																	
FCAW	Flux Cored Arc Welding																																	
IC	Internal Concavity																																	
ICP	Inadequate Cross Penetration																																	

		ISI	Isolated Slag Inclusion
		IU	Undercutting adjacent to the root pass
		JKP	Jabatan Pembangunan Kemahiran (Department of Skills Development)
		LB	Linear Buried (Indication)
		LPTA	Lembaga Perlesenan Tenaga Atom (Atomic Energy Licensing Board)
		LS	Linear Surface (Indication)
		PT	Liquid Penetrant Testing
		PWHT	Post-Weld Heat Treatment
		SWE	Single Wall Exposure
		SWV	Single Wall Viewing
		T	Transverse (indication)
		TCG	Time Corrected Gain
		UT	Ultrasonic Testing
		VC	Volumetric Cluster
		VI	Volumetric Individual
		AC	Alternating Current
		AI	Accumulated Imperfections
		AUT	Automatic Ultrasonic Testing
		BT	Burn Through
		C	Crack
		CP	Cluster Porosity
		CTOD	Crack Tip Opening Displacement
		CRT	Computerized RT
		DC	Direct Current
		DWE	Double Wall Exposure
		DWV	Double Wall Viewing
		ESI	Elongated Slag Inclusion
		EU	Undercutting adjacent to the cover pass
		FCAW	Flux Cored Arc Welding
		IC	Internal Concavity
		ICP	Inadequate Cross Penetration
		ISI	Isolated Slag Inclusion
		IU	Undercutting adjacent to the root pass
		JKP	Jabatan Pembangunan Kemahiran (
		LB	Department of Skills Development)
		LS	Linear Buried (Indication)
			Linear Surface (Indication)

		PT Liquid Penetrant Testing PWHT Post-Weld Heat Treatment SWE Single Wall Exposure SWV Single Wall Viewing T Transverse (indication) TCG Time Corrected Gain UT Ultrasonic Testing VC Volumetric Cluster VI Volumetric Individual
PART II 1.1	PART II 1.1	Add the following: Unless agreed otherwise by the Principal, the GTAW process shall be used for the root and second passes. A manual, semi-automatic, or automatic welding technique, or combination of these techniques may be used. Filler metal SHALL be used for all passes. Roll welding may be accepted by the Principal when an automatic welding process is used. GMAW, GTAW, and gas-shielded FCAW shall be restricted to construction areas protected against wind and draught. This PTS also covers the procedure requirements and acceptance standards to be applied to qualification and production welds destructively tested and/or inspected by radiographic, ultrasonic, or liquid penetrant NDT methods. PTS clauses that do not satisfy the local regulations will be addressed in specific amendments to this PTS as project specific specifications.
1.5.1	4.2.1	Add the following: This PTS applies to the welding of duplex (for example grades such as UNS S31803, S32205, etc, in which PRE is less than 40 but more than 34) and super duplex stainless steel (for example grades such as UNS S32750, S32760, etc, in which PRE is 40 or greater) pipe, flanges, and fittings.
1.5.3.1	4.2.3.1	Add the following: The shielding and back purge gas shall be classified in accordance with ISO 14175. Purity and dew point shall be selected by the contractor in order to achieve the requirements in this PTS. Hydrogen shall not be added. The shielding gas for the root and second passes shall be Ar/2-3 %N. Backing gas may be 100% Nitrogen. Backing gas shall be maintained during welding operations until 10 mm of weld metal is deposited. The component concentrations of the gas shall be as specified on the WPS and shall be the same for procedure qualification and production welding.
2.1	5.1	Add the following:

		All welding SHALL be qualified using a Welding Procedure Specification (WPS) and corresponding Procedure Qualification Record (PQR), as detailed in Section 5 of this document. Qualification of welding procedures shall include testing as referenced in Appendix (A2.1) in addition to those as defined below. Separate procedure qualification shall be done simulating partial penetration repairs. Weld root repairs are not allowed and shall require a cut out and re-weld. Only WPSs agreed by the Principal shall be used for test welding. When indicated by the Principal in the enquiry document, previously qualified welding procedure specifications may be offered for agreement subject to the following: - the WPQR is fully in accordance with this PTS; - the WPS is amended to reflect the project-specific details; - the welding shall be within the essential variables defined in this PTS; and - the WPS and WPQR are owned and controlled by the Contractor or sub-contractors under direct control of the Principal contractor. - Mechanical and metallographic testing for WPQR has been witnessed by an independent body (third party) Provisions for the welding and testing of fillet welds, included in API 1104 and this PTS, shall be taken to apply also to full penetration branch welds. Butt welding procedures, branch welding procedures, fillet welding procedures, and repair welding procedures shall be qualified separately. Test welding shall be performed under simulated site conditions using pipe nipples with a length of 500 mm or one OD, whichever is the greater. For flange/fitting welds, suitably sized test rings may be used. The use of historical reeling data may be permitted subject to meeting the requirements detailed below and being acceptable to the Principal. Where acceptable, mechanical test specimens shall be artificially strained 5% (or at level that is representative of the installation and operational conditions) aged at 250°C for one hour and be conducted in accordance with Section 8.5.2 of this specification, unless otherwise agreed with the Principal. For pipeline girth welds subjected to plastic deformation during installation (i.e. reeling), fracture toughness testing and ECA should be conducted by the CONTRACTOR in accordance with DNV-OS-F101 and DNV-RP-F108. The proposed philosophy and methodology shall be approved by the Principal prior to testing. A selection of the procedure qualification welds shall be subjected to full-scale simulation bending at the maximum strain predicted during installation. Cognizance shall also be taken of potential high strains and the effect of fatigue during operation and should be assessed if deemed significant by the PRINCIPAL the number of cycles shall be determined from the number of cycles required for installation, plus any contingency
--	--	--

		operations and agreed with the Principal. These strained welds shall then be aged for 1 hour at 250°C. Weld repair procedures shall be included in the full-scale trial and shall be located to undergo maximum strain. The test welds shall be fabricated into the test string in a manner that ensures that the 12 o'clock welding position of one weld and the 3(9) o'clock welding position of the second weld is located at the point of maximum bending strain, i.e. the outside of the bend. The number of welds within the test string shall be sufficient to account for WPQ mechanical test requirements.
2.3.2.6	5.3.2.6	Add the following: Where applicable, electrical stick out, contact tube-to-work distance, and wire feed speed shall be specified for each weld pass. If pulsed welding is used, background current and pulse parameters, e.g. waveform, peak current, duration and frequency, shall be fully specified. Specific machine programs tied to specific models of power supply shall be specified where applicable.
2.3.2.7	5.3.2.7	Delete the following: 2.3.2.7 Flame characteristics Delete this section and replace with the following: Oxyfuel gas welding shall not be used. And replace with: 5.3.2.7 Flame characteristics Delete this subsection.
2.3.2.11	5.3.2.11	To change reference from 4.3 to 7.3
2.3.2.12	5.3.2.12	To change reference from 4.7 to 7.7
2.3.2.13	5.3.2.13	To change reference from 4.11.1 and 2.11.2 to 7.11.1 and 7.11.2
2.3.2.14	5.3.2.14	To change reference from 4.15 to 7.15
2.3.2.15	5.3.2.15	Add the following: The EN, ISO or AWS flux classification, the Manufacturer, brand name, and the size shall also be specified.
2.3.2.17	5.3.2.17	Add the following: The allowable range of heat input for each welding process and each weld pass shall be specified except when ROL is adopted to define welding speed. Heat input shall be shown in kJ/mm.
2.3.2.19	5.3.2.19	To change reference from 4.13 to 7.13
	5.4.2.13	Add following new sub-section: Preheat and interpass temperature Any decrease in the preheat temperature or increase in the interpass temperature as compared to that recorded on the WPQR shall constitute a change in essential variable.

2.4.2.15	5.4.2.14	Delete this subsection and replace with the following: The inclusion or omission of PWHT, or any change in PWHT parameters, shall constitute a change in essential variables. Add the following new subsections: 5.4.2.15 Welding parameters or arc energy
2.6.1	5.6.1	To change reference from 8 to 11. To change reference from 6 to 9. To change reference from (2.6.6-2.6.8) to (5.6.6 – 5.6.8)
2.6.9.1	5.6.9.1	Add the following: Pitting tests shall be performed in accordance with the procedure detailed in Appendix 2. The test temperature shall be 22 °C for duplex and 35 °C for super duplex.
2.6.10.3	5.6.10.3	To change reference from 2.6.8.3 to 5.6.8.3
2.7	5.7	To change reference from 2.3 to 5.3
2.8.2	5.8.2	To change reference from 2.6.6 to 5.6.6 To change reference from 2.6.7 to 5.6.7
2.8.3	5.8.3	To change reference from 2.6.6.3 to 5.6.6.3 To change reference from 2.6.7.2 to 5.6.7.2
2.10.1	5.10.1	To change reference from 2.6 and 7.1.3 to 5.6 and 10
2.10.2	5.10.2	To change the following: Destructive tests shall be as follows: - 1 transverse tensile - 5.6.2; - 1 macro-hardness test - (5.6.6) - ferrite measurement for partial penetration repairs (5.6.7) which shall include measurements made in the new HAZ formed in the original weld; - Charpy testing at the locations shown in BS 4515-2; - Ferric chloride corrosion testing in accordance with Appendix 2.
3.1	6.1	To include the following: Qualification of welder shall follow the requirement of (section 6) of this PTS and clause 4.5 of PTS 30.10.60.18
3.4	6.4	To change reference from 6 to 9
3.5.1	6.5.1	To change reference from 2.6.6 to 5.6.6 To change reference from 6 to 9
	6.5.6	Add the following: Prior to cutting, the test welds shall be liquid-penetrant tested in accordance with 11.3 and shall meet the requirements of (9).
3.5.7	6.5.8	To change reference from 2.6.6 to 5.6.6 To change reference from 6 to 9
3.6.1	6.6.1	Delete this subsection and replace with the following: The qualification butt weld shall be examined by radiography inclusive of Computerized RT prior to the destructive testing specified in (6.5). Used of AUT shall be subject to Principal

		approval.
4.14	7.14	Add the following: Welds shall be left as welded and shall not be treated with a flame torch or other mechanical means to change their appearance other than cleaning and dressing operations specified in the WPS. Welds shall not be peened. Special care shall be taken in the selection and usage of tools to avoid contamination. Tools shall be iron free and be suitable for use with Stainless Steels When fabrication is completed, all surfaces adjacent to the welds shall be cleaned of spatter, burrs and other imperfections which could interfere with radiographic or ultrasonic inspection. Special care shall be taken in the selection and usage of tools to avoid contamination.
4.15	7.15	Add the following: The oxygen content of the backing gas, measured in the effluent gas immediately prior to welding, shall not exceed 0.50 %. Measurement shall be made by means of a suitable oxygen meter. The backing gas shall be maintained and monitored for the minimum number of weld passes qualified by the WPQR. In case "needle purge" method is used (for tie-in welds), to protect the root against oxidation, precautions shall be taken to ensure sufficient purge quantity. Welders shall understand and be capable of using this method and should be tested during qualification using "mock-up" fixtures.
5.2	8.2	To change reference from 6 to 9
5.3	8.3	To include the following: Welding inspection personnel shall hold a valid welding inspection qualification and certificate from one or more of the following: • JPK • CSWIP • BGAS • AWS • Other certifying body agreed by the Principal.
5.5	8.5	To change reference from 8 to 11 Add the following: The Principal reserves the right to select a production weldment for examination and destructive testing in accordance with the welding procedure qualification test requirements.
6.3.1	9.3.1	Re-phrase the following: Inadequate penetration without high-low
	9.3.3	Add the following new sub-section: 9.3.3 Inadequate cross penetration

		Change the title as follows: 9.3.3 Incomplete joint penetration Delete this subsection, including Figure 15, and replace with the following: Any incomplete joint penetration shall be considered a defect.
6.3.4	9.3.5	To change reference from Figure 16 to Figure 17
6.5.2	9.5.2	To change reference from (6.1 and 6.3) to (9.1 and 9.3)
	10.1.1	Add new following sub-section: Cracks Delete this subsection and replace with the following: For cracks, other than crater cracks, the complete weld and HAZ shall be removed. The cause of all cracks shall be investigated and reported to the Principal by the Contractor.s
8.1.1	11.1.1	Delete this subsection and replace with the following: Radiographic testing shall be performed in accordance with ISO 17636 Class B. The radiation shall be X-ray. The technique shall be film outside, source of radiation inside. Where the source of radiation cannot be located inside the pipe, the Principal may agree to use of the film and source of radiation outside: double wall, single image technique.
8.1.3	11.1.3	Delete the third paragraph, including the formula and definitions, and replace with the following: The minimum source-to-specimen distance shall be calculated in accordance with ISO 17636 for Class B radiographic testing.
8.1.4	11.1.4	Type of Image Quality Indicators (IQI) Add to the subsection the following: IQIs shall be wire type.
8.1.5	11.1.5	Delete this subsection and replace with the following: For production radiographic testing, IQI selection, number, location and appearance in radiographic images shall be in accordance with ISO 17636.
8.1.6	11.1.6	Re-phrase with the following: Placement of Image Quality Indicators (IQI)
	11.1.13	11.1.13 Radiation protection Replace by the following: The Contractor shall be responsible for the protection of all persons in the vicinity of the radiographic equipment. The Contractor shall familiarise himself with the safety requirements as set out in PTS 60.15.07.01, Ionizing Radiation Guidelines. This document shall form the basis of safety precautions to be applied in conjunction with LPTA, or any local statutory regulations or other legislation which may exist. The Contractor shall satisfy the Principal that all aspects of relevant safety

		procedures are adequately covered and have been implemented. The Contractor shall identify the areas where radiography is being performed by means of signs, symbols, etc. and shall be responsible for the policing of such areas. The Contractor shall be responsible for effectively coordinating the radiographic functions so as to minimise interference with other primary activities.
SECTION 9	SECTION 12	Re-phrase with the following: AUTOMATIC WELDING WITH FILLER METAL ADDITIONS
PART IV	PART III	Add new PTS PTS 30.10.60.18 Welding of Metals (amendment/supplements) to API RP 582
PART IV	PART III	New edition of API 1104 Twentieth edition, October 2005 with Errata/Addendum of July 2007 and December 2008
PART IV	PART III	New ISO reference Non-destructive testing of welds – Radiographic testing of fusion welded joints, ISO 17636
	APPENDIX 3	Add new appendix: APPENDIX 3 DETERMINATION OF THE VOLUME FRACTION OF FERRITE IN DUPLEX STAINLESS STEEL BY SYSTEMATIC POINT COUNT