

PETRONAS TECHNICAL STANDARDS

TECHNICAL SPECIFICATION

LINEPIPE SPECIFICATION

(AMENDMENTS/SUPPLEMENTS TO API 5L 44th
Edition / ISO 3183:2007)

PTS 31.40.20.38

October 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 – 01



PTS No:	31.40.20.38
PTS Title:	Linepipe Specification (Amendments/Supplements To API 5L 44th Edition / ISO 3183:2007

PTS 31.40.20.38 – Linepipe Specification (Amendments/Supplements To API 5L 44th Edition / ISO 3183:2007 (October 2011, Revision 0) has been developed to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. It incorporates both PTS 31.40.20.35 and PTS 31.40.20.37 into one volume, which are specifications for Non-Sour and Sour service respectively.

Both PTS 31.40.20.35 and PTS 31.40.20.37 will be removed from PTS binder / e-repository from herein onwards.

The custodian of this PTS is:
Name: Hasbullah B Abu Hassan
Tel. No: 03 – 2783 6501

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

Document Approval

	Name	Designation	Date	Signature
Prepared	Tan Yew Min	Staff Engineer (Materials) MCI, GTS	21.10.11	
	Tan Su Anne	Engineer (Materials) MCI, GTS	21.10.11	
Reviewed	Hasbullah B Abu Hassan	Custodian Engineer (Materials) MCI, GTS	21/10/11	
Approved	Zamaluddin B Ali	Technical Authority, MCI, GTS	21/10/11	
Verified	Che Wan Ibrahim B Wan Sudin	Senior Manager, MCI, Engineering, GTS	21/10/11	
Verified	Saifol Mualim B Ahmad Yahaya	General Manager, Engineering, GTS	28/10/11	
Endorsed	Pau Kiew Huai	Senior General Manager, GTS	4.11.11	

Revision History

Rev No.	Reviewed by	Approved by	Date
0	Hasbullah B Abu Hassan	Zamaluddin B Ali	October 2011

REVIEW COMMITTEE ACKNOWLEDGEMENT

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

No.	Name	Designation	Company
1.	Dr David Baxter	Principal Consultant Materials	ATKINS Boreas
2.	Hasbullah B Abu Hassan	Custodian Materials	GTS
3.	Kamal Azam B Ibrahim	Manager	DEMC/DD/PCSB
4.	Ghazali B M Zin	Manager, Materials	DEMC/DD/PCSB
5.	Hasbi Abd Razak	Principal Materials Engineer	DEMC/DD/PCSB
6.	M Zamri B Jaafar	Sr Materials Engineer	DEMC/DD/PCSB
7.	Anuwar B A Wahab	Principal Pipeline Engineer	DEPL/PCSB
8.	Ir Hj Ahmad Khairiri B A Ghani	Principal Construction Engineer	DD/PCSB
9.	M Fauzi B Badaruddin	Principal Pipeline Engineer	DEPL/PCSB
10.	Halimi B Morad	Staff Pipeline Engineer	GTS
11.	Ahmad Sirwan B M Tuselim	Principal Pipeline Engineer	GTS
12.	Tan Yew Min	Staff Materials Engineer	GTS
13.	Siti Khadijah Bt Md Rawi	Materials Engineer	DEMC/PCSB
14.	Tan Su Anne	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 the 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, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

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

When Contractors or Manufacturers/Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, it is expected of them to follow those design and engineering practices which will achieve 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 owner.

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) and 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 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 PTS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PETRONAS may at any time require information satisfactory to PETRONAS in order to ascertain how users implement this requirement.

TABLE OF CONTENTS

PART I	INTRODUCTION
1.1	SCOPE
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS
1.3	DEFINITIONS
1.4	GUIDANCE FOR USE
1.5	CROSS-REFERENCES
PART II	AMENDMENTS/SUPPLEMENTS TO API 5L 44th EDITION / ISO 3183:2007
2.	CONFORMITY
3.	NORMATIVE REFERENCES
4.	TERMS AND DEFINITIONS
5.	SYMBOLS AND ABBREVIATED TERMS
6.	PIPE GRADE, STEEL NAME AND DELIVERY CONDITION
7.	INFORMATION TO BE SUPPLIED BY THE PURCHASER
8.	MANUFACTURING
9.	ACCEPTANCE CRITERIA
10.	INSPECTION
11.	MARKING
12.	COATINGS AND BEVEL PROTECTORS
13.	RETENTION OF RECORDS
ANNEX A	(NORMATIVE) SPECIFICATION FOR WELDED JOINTERS
ANNEX B	(NORMATIVE) MANUFACTURING PROCEDURE QUALIFICATION FOR PSL 2 PIPE
ANNEX C	(NORMATIVE) TREATMENT OF SURFACE IMPERFECTIONS AND DEFECTS
ANNEX D	(NORMATIVE) REPAIR WELDING PROCEDURE
ANNEX E	(NORMATIVE) NON-DESTRUCTIVE INSPECTION FOR OTHER THAN SOUR SERVICE OR OFFSHORE SERVICE
ANNEX F	(NORMATIVE) REQUIREMENTS FOR COUPLINGS (PSL 1 ONLY)
ANNEX G	(NORMATIVE) PSL 2 PIPE WITH RESISTANCE TO DUCTILE FRACTURE PROPAGATION
ANNEX H	(NORMATIVE) PSL 2 PIPE ORDERED FOR SOUR SERVICE
ANNEX J	(NORMATIVE) PSL 2 PIPE ORDERED FOR OFFSHORE SERVICE
ANNEX K	(NORMATIVE) NON-DESTRUCTIVE INSPECTION FOR PIPE ORDERED FOR SOUR SERVICE AND/OR OFFSHORE SERVICE
ANNEX N	(NORMATIVE) IDENTIFICATION / EXPLANATION OF DEVIATIONS
PART III	REFERENCES

PART I INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the manufacture and supply of carbon and low-alloy steel linepipe. It replaces and provides an update to the following documents:

PTS 31.40.20.30 Linepipe for use in oil & gas operations under non-sour conditions
PTS 31.40.20.31 Linepipe for use in oil & gas operations under sour conditions
(which were based on API 5L 40th edition)

and

PTS 31.40.20.35 Linepipe for non-critical service
PTS 31.40.20.37 Linepipe for critical service
(which were based on ISO 3183-1 2nd edition and ISO 3183-3:1999 respectively)

The new harmonised API 5L 44th edition / ISO 3183:2007 standard describes two basic levels of standard technical requirements for linepipe, in the form of two product specification levels (PSL 1 and PSL 2). Level PSL 2 has additional mandatory requirements for chemical composition, tensile properties, notch toughness and non-destructive examination.

For all applications previously designated as “sour” or “critical” PSL 2 pipe should be specified. For “non-sour” or “non-critical” applications the specification level may still be PSL 2, although in some instances the Principal may specify PSL 1.

In addition to the two product specification levels, a number of additional requirements are covered by annexes to the API 5L 44th edition / ISO 3183 document. In particular;

Annex G - Pipe with resistance to ductile fracture propagation
Annex H - Pipe ordered for sour service
Annex J - Pipe ordered for offshore service

For liquid conveying lines, Annex G is not required, but for pipe for use in dry, lean natural gas pipelines, Annex G shall be specified. Pipelines conveying rich gas, multiphase fluid, or lean gas at very high pressures, may have a higher Charpy impact energy requirement than specified in Annex G, and in this case requirements shall be specified by the Principal.

For pipe that is ordered for sour service, Annex H should be specified.

For pipe that is ordered for offshore service Annex J should be specified.

It should also be noted that this document is based on API 5L 44th edition (rather than ISO 3183:2007) so the national amendments described in Annex N should be regarded as applicable. The amendments to API 5L 44th edition made in Errata 1 (issued in January 2009) and Addendum 1 (issued in February 2009) shall also be regarded as applicable. However, where this PTS calls for an amendment, this shall take priority.

Part II of this PTS gives amendments and supplements to clauses of API 5L 44th edition, which are considered necessary to ensure pipeline integrity in conformance with PETRONAS Group requirements.

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 intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities, and supply/marketing installations.

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

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or 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 which 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** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Manufacturer	Term used in API 5L / ISO 3183, which shall be taken to mean the Manufacturer/Supplier.
Purchaser	Term used in API 5L / ISO 3183, which shall be taken to mean the Principal.
Production sample interruption testing	Sample testing of pipes from continuous production. No normal production during sampling is necessary.
Lean gas	A gas mixture containing a minimum of 95% methane.

1.4 GUIDANCE FOR USE

The amendments to API 5L 44th edition given in Part II are directly related to equivalent clauses/subclauses in that document. For clarity, the clause numbering of API 5L has been used as far as possible. Where clauses in API 5L 44th edition are referenced within this PTS, it shall mean those clauses as amended by this PTS. Clauses in API 5L 44th edition that are not amended by this PTS shall remain valid as written. It should also be noted that as this document is based on API 5L (rather than ISO 3183) the national amendments described in Annex N should be regarded as applicable. However, where this PTS calls for an amendment, this shall take priority.

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).

PART II AMENDMENTS/SUPPLEMENTS TO API 5I 44th EDITION / ISO 3183:2007

2. CONFORMITY

2.3 Compliance to this international standard

Replace first sentence with the following:

The Manufacturer/Supplier should maintain and operate a quality assurance system in accordance with ISO 9001. The Manufacturer/Supplier may maintain and operate a quality assurance system based on an alternative standard, which may be considered by the Principal for agreement.

3. NORMATIVE REFERENCES

Add the following:

See also (Part III) of this PTS.

4. TERMS AND DEFINITIONS

4.18 High Frequency Welded (HFW) Pipe

Amend as follows:

Change "greater than 70 kHz" to "greater than 150 kHz".

4.27 Low Frequency Welded (LFW) Pipe

Amend as follows:

Change "less than 70 kHz" to "less than 150 kHz".

5. SYMBOLS AND ABBREVIATED TERMS

5.2 ABBREVIATIONS

CEV	Carbon Equivalent Value
DWTT	Drop Weight Tear Test
FL	Fusion Line
HAZ	Heat Affected Zone
HV10	Vickers Hardness determined with a 98.07 N test force
TD _{min}	Minimum design temperature of the pipeline
WPQR	Welding Procedure Qualification Record
WPS	Welding Procedure Specification

6. PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe grade and steel grade

Add the following

- 6.1.4 Only those grades nominated in API 5L 44th edition / ISO 3183: 2007, as modified by this PTS, shall be supplied; intermediate grades shall not be used.

Delete Note a) of Table 1.

7. INFORMATION TO BE SUPPLIED BY THE PURCHASER

7.1 General information

Delete the first sentence and replace with the following:

The Principal should provide the following minimum information at the enquiry stage of the order, except that requirements specifically addressed by this PTS need not be repeated:

d) Replace with the following:

reference to API 5L 44th edition / ISO 3183:2007.

f) Add the following:

or, whether constant inside diameter requirements are to be applied. In such cases the required inside diameter shall be specified.

h) Add the following:

such as sour service (H), offshore service (J), and resistance to ductile fracture propagation (G).

Add the following:

i) whether pipe is mother pipe for bends

j) minimum design temperature

7.2 Additional information

a) Items that are subject to mandatory agreement, if applicable:

- 1) Delete this item, as intermediate grades shall not be supplied (see 6.1.4 above).
- 2) Delete this item, as intermediate grades shall not be supplied (see 6.1.4 above).
- 4) Delete this item, as grade L415N or X60N is not included in amended Table 5 (below).
- 6) Delete this item, as the footnote is not included in amended Table 5 (below).
- 9) Delete this item, as jointers shall not be supplied (see 8.11 below).

Add the following:

- 10) which of the Manufacturer/Supplier's quality control procedures.
- 12) the requirement for elevated temperature tensile testing and the acceptance criteria;
NOTE: Several pipeline design standards require elevated temperature tensile testing for pipeline design temperatures above 150°C.

b) Items that apply as prescribed, unless otherwise agreed:

- 1) Delete this item, as range is specified in amended 8.9 below.
- 2) Delete this item, as equation is specified in amended 8.9 below.

- 4) replace “[see Table 5, footnotes c), e), f), g), h) and i)]” with “[see amended Table 5, footnote d)]” as other footnotes no longer apply in amended Table 5 (below).
- 7) Delete this item, as tolerances for pipe length are specified in amended 9.11.3.3.
- 11) Delete this item, as jointers shall not be supplied (see 8.11 below).

Add the following:

- 13) Manufacturing procedure qualification and inspection test plan (ITP) to be submitted prior to commencement of manufacturing process or first day production test in accordance with Annex B.

c) Items that apply, if agreed:

- 3) Delete this item, as intermediate grades shall not be supplied (see 6.1.4 above).
- 4) Replace “double seam SAWL pipe” with “double seam SAWL or COWL pipe” for consistency with amended Table 2 below.
- 5) Delete this item, as seam heat treatment is specified in amended 8.8 below.
- 6) Delete this item, as pipe containing strip/plate end welds shall not be supplied, as per amended 8.10 below.
- 7) Delete this item, as jointers shall not be supplied (see 8.11 below).
- 8) Replace with “CVN impact test temperature for PSL2 pipe with $t > 40$ mm (see 9.8.2 and Table 8a)”
- 10) Delete this item, as impact test requirements are specified in amended Table 8 below.
- 11) Replace with “DWT test of the pipe body of PSL 2 welded pipe with $D \geq 407$ mm (16.000 in) (see 9.9.1 and amended Table 18)”
- 12) Delete this item, as DWT test temperature is specified in amended 9.9.1.
- 22) Delete this item, as alternatives not allowed, as per amended 10.2.5 below.
- 23) Delete this item, as hardness testing requirements are specified in amended 9.16 and 10.2.4.9 below.
- 25) Delete this item, as test pressure is specified in amended 10.2.6 below.
- 27) Delete this item, as requirement is specified in amended Table 10 below.
- 31) Delete this item, as location is specified in amended 11.2 below.
- 35) Add para on requirement for colour identification for HFW pipe, see 11.2.7 below.
- 40) Delete this item, as this is specified in amended 8.1.
- 41) Delete this item, as requirement is specified in amended E.3.1.2 below.
- 51) Delete this item, as requirement is specified in amended H.3.3.2.4 below.
- 52) Delete this item, as pipe containing strip/plate end welds shall not be supplied, as per amended 8.10 below.

8. MANUFACTURING

8.1 Process of manufacture

Add the following:

Steel making and pipe manufacturing activities shall be controlled by a quality plan specific to the purchase order. For PSL 2 pipe, qualification of the manufacturing processes shall be determined from the results of first-day production tests, in accordance with Annex B, unless otherwise agreed with the Principal. The Principal may also require that qualification be undertaken on a limited production quantity before allowing unrestricted production. Change of steel making subcontractor shall necessitate repetition of first-day production testing. For PSL 1 pipe qualification of the manufacturing processes in accordance with Annex B shall not be required unless specified by the Principal.

Delete Table 2 and replace with the following

Amended Table 2 Acceptable processes of manufacture and product specification levels

Type of pipe or pipe end	PSL 1 pipe grade					PSL 2 pipe grade	
	L175 or A25 ^b	L175P or A25P ^b	L210 or A	L245 or B	L290 or X42 to L485 or X70	L245 or B to L555 or X80	>L555 or X80 to L830 or X120
Type of pipe							
SMLS	X	X	X	X	X	X	-
LFW	X	-	X	X	X	-	-
HFW	X	-	X	X	X	X	-
LW	-	-	-	-	X	-	-
SAWL	-	-	X	X	X	X	X
SAWH ^c	-	-	X	X	X	X	X
COWL	-	-	X	X	X	X	-
COWH ^c	-	-	X	X	X	X	-
Double seam SAWL ^d	-	-	X	X	X	X	X
Double seam COWL ^d	-	-	X	X	X	X	-
Type of pipe end							
Belled end ^e	X	-	X	X	X	-	-
Plain end	X	-	X	X	X	X	X
Plain end for special coupling	X	-	X	X	-	-	-
Threaded end ^f	X	X	X	X	-	-	-
^b Grades L175, L175P, A25 and A25P are limited to pipe with D ≤ 141.3 mm (5.563 in) ^c Helical-seam pipe is limited to pipe with D ≥ 114.3 mm (4.500 in) ^d Double seam pipe shall only be supplied if agreed with the Principal, and only for pipe with D ≥ 914 mm (36.000 in) ^e Belled-end pipe is limited to pipe with D ≤ 219.1 mm (8.625 in) and t ≤ 3.6 mm (0.141 in) ^f Threaded-end pipe is limited to SMLS and longitudinal seam welded pipes with D ≤ 508 mm (20.000 in)							

NOTE: PSL2 pipe for sour service or offshore service shall comply with the further restrictions specified in H.3 and J.3 respectively.

Delete Table 3 and replace with the following

Amended Table 3 Acceptable manufacturing routes for PSL 2 pipe

Type of pipe	Starting material	Pipe forming	Pipe heat treatment	Delivery condition
SMLS	Ingot, bloom or billet	Normalizing forming ^b	-	N
		Hot forming	Normalizing	N
		Hot forming and cold finishing	Quenching and tempering	Q
HFW	Normalizing-rolled strip	Cold forming	Heat treating ^a of weld area only	N
	Thermomechanical-rolled strip	Cold forming	Heat treating ^a of weld area only	M
			Heat treating ^a of weld area and stress relieving of entire pipe	M
	Hot-rolled strip	Cold forming	Normalizing	N
			Quenching and tempering	Q
		Cold forming followed by hot reducing under controlled temperature resulting in a normalized condition ^c	-	N
SAW or COW	Normalized or normalizing-rolled strip or plate	Cold forming	-	N
	As-rolled. Thermomechanical-rolled, normalizing-rolled or normalized	Cold forming	Normalizing	N
	Thermomechanical-rolled strip or plate	Cold forming	-	M
	Quenched and tempered plate	Cold forming	-	Q
	As-rolled. Thermomechanical-rolled, normalizing-rolled or normalized strip or plate	Cold forming	Quenching and tempering	Q
	As-rolled. Thermomechanical-rolled, normalizing-rolled or normalized strip or plate	Normalizing forming ^d	-	N
^a See 8.8 for applicable heat treatments ^b The finishing temperature shall be greater than 780°C. Pipe finished at a lower temperature than 780°C shall be subject to a further normalizing heat treatment. ^c Hot reducing or thermomechanical processing of HFW pipe is only to be used by agreement with the Principal ^d Normalizing forming of SAW or COW pipe is only to be used by agreement with the Principal				

Add the following:

For PSL 1 pipe the manufacturing route shall be at the discretion of the manufacturer, with the following exclusions:

- SMLS pipe shall not be supplied in the as-rolled condition
- Hot reducing or thermomechanical processing of HFW pipe is only to be used by agreement with the Principal
- Normalizing forming of SAW or COW pipe is only to be used by agreement with the Principal

8.2 Processes requiring validation

Add the following:

The Manufacturer/Supplier shall nominate at least one authorised welding co-ordinator. The Manufacturer/Supplier's welding coordination personnel shall have a documented job specification in accordance with ISO 14731.

Welding equipment shall be fitted with automatic welding parameter monitoring and recording.

Welding operations shall be controlled by a WPS. The WPS shall contain the information, appropriate to the welding process, required by ISO 15609-1 or ASME IX, including the control of heat input. For HFW, the WPS shall also state the following parameters:

- Electrical or induction frequency;
- Welding power input;
- Welding speed;
- Welding temperature.

The WPQR for each seam welding WPS should be generated from the first-day production test results relating to the weld seam. Change of consumable Manufacturer and/or trade name shall be outside of the range of approval.

NOTE: The range of approval for the WPS with respect to parent material thickness may be restricted by the Charpy test requirements of Table 6 dependent upon the test temperature selected.

Welders and welding operators shall be tested and approved in accordance with ISO 9606-1 or ISO 14732 as appropriate. Testing may be by production sample testing. Destructive testing may be omitted.

NOTE: Repair welding requirements are addressed in Annex D.

8.4 Tack Welds

Add the following:

- 8.4.3 Tack welds shall be a continuous single pass. Intermittent tack welding shall not be permitted.

8.8 Treatment of weld seams in EW and LW pipe

Delete this clause and subclauses (8.8.1 and 8.8.2) and replace with the following:

For all grades, the weld seam and the HAZ shall be heat treated so as to simulate a normalizing heat treatment. Full body normalizing shall also be permitted.

For HFW pipe, the abutting edges of the strip or plate should be sheared, milled or machined before welding.

Note: Rotary machining is not considered to constitute machining.

8.9 Cold sizing and cold expansion

Delete this clause (and subclauses 8.9.1 to 8.9.3) and replace with the following:

All SAWL pipe shall be cold expanded by a mechanical process. Expansion to produce a sizing ratio, S_r , of between 0.008 and 0.015 shall be applied. The sizing ratio shall be defined as follows:

$$S_r = \frac{|D_a - D_b|}{D_b}$$

D_a = OD after sizing

D_b = OD before sizing

For seamless or HFW pipes which are cold sized to their final dimensions and for which no further heat treatment, or only a heat treatment of the weld area, is carried out, the sizing ratio shall not exceed 0.015.

8.10 Strip/plate end welds

Delete this subclause and replace with the following:

Strip/plate end welds are not permitted in the delivered pipe.

8.11 Jointers

Delete this subclause and replace with the following:

The delivery of jointers is not permitted.

9. ACCEPTANCE CRITERIA

9.1 General

9.1.2 Delete this subclause and replace with the following:

Pipe manufactured to a higher grade shall not be substituted for pipe ordered to a lower grade, unless approved by the Principal.

9.2 Chemical composition

9.2.1 Delete "and the chemical composition for intermediate grades shall be as agreed, but consistent with those given in Table 4"

Add the following:

The carbon equivalent value, CE_{IIW} determined using Equation (3) below, shall be 0.43%.

9.2.2 Delete this clause and replace with the following:

For PSL 2 pipe with $t \leq 25.0$ mm (0.984 in) the chemical composition shall be as given in the amended Table 5 below.

Add the following:

The Manufacturer shall propose a target product analysis in the manufacturing specification. A single value target CEV shall also be stated. The range of acceptable variations in the product analysis shall be as follows:

C	0.03
Mn	0.30
Si	0.25
Ni	0.10
Cu	0.10
V	0.03
Nb	0.02
Al	0.03
Ti	0.015
Mo	0.05
Cr	0.05

NOTE: The above figures represent the total range and not a plus or minus tolerance. Therefore, for example, if the proposed target carbon concentration is 0.05%, all product analyses shall lie within a 0.03% total range (as specified above), which could be 0.05 – 0.08%, 0.04 – 0.07%, 0.03 – 0.06% etc. at the discretion of the manufacturer. Note also that the requirements specified in Tables 4, 5, H.1 and J.1 shall still apply.

The range of acceptable variation in CEV shall be ± 0.02 units

NOTE PSL 2 pipe ordered for sour service shall meet the additional chemical composition requirements described in Annex H. Similarly, PSL 2 pipe ordered for offshore service shall meet the requirements described in Annex J.