

MATERIAL AND EQUIPMENT STANDARD**FOR****LINE PIPE****THIRD EDITION****FEBRUARY 2014**

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract document.

VENDOR AND SUPPLIER :

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR :

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL :

Is used where a provision is mandatory.

SHOULD :

Is used where a provision is advisory only.

WILL :

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

MAY :

Is used where a provision is completely discretionary.

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0. INTRODUCTION

The amendments to API Spec 5L (Forty-Fifth Edition) given in this Specification are directly related to the equivalent sections or clauses in API Spec. 5L. For clarity, the section and paragraph numbering of API Spec. 5L has been used as far as possible. Where clauses in API Spec. 5L are referenced within this Specification, it shall mean those clauses are amended by this Specification. Clauses in API Spec. 5L that are not amended by this Specification shall remain valid as written.

Guidance for Use of this Specification

The following annotations, as specified hereunder, have been used at the bottom right hand side of each clause or paragraph to indicate the type of change made to the equivalent clause or paragraph of API Spec. 5L.

Sub. (Substitution) "The clause in API Spec. 5L shall be deleted and replaced by the new clause in this Specification"

Del. (Deletion) "The clause in API Spec. 5L shall be deleted without any replacement"

Add. (Addition) "The new clause with the new number shall be added to the relevant section of API Spec. 5L"

Mod. (Modification) "Part of the clause or paragraph in API Spec. 5L shall be modified and/or the new description and/or statement shall be added to that clause or paragraph as given in this Specification"

1. SCOPE

This standard specifies requirements for manufacturing of product specification level PSL 2 of seamless and welded pipe for use in pipeline transportation systems in the petroleum, petrochemical and natural gas industries.

Note 1:

Those clauses that apply to PSL2 and are not amended by this standard remain valid as written.

Note 2:

This is a revised version of this standard, which is issued as revision (3)-2014. Revision (2)-2004 of the said standard specification is withdrawn.

2. CONFORMITY

2.1 Units of Measurement

This Standard is based on International System of Units (SI), as per [IPS-E-GN-100](#) except where otherwise specified. (Sub.)

2.2 Rounding

Refer to [IPS-E-GN-100](#), part 5.6 "Guide for the Rounding of Numbers". (Sub.)

3. NORMATIVE REFERENCES

IPS (IRANIAN PETROLEUM STANDARDS)

[IPS-E-GN-100](#) "Engineering Standard for Units"

4. TERMS AND DEFINITIONS

4.23 HFW Pipe

High-frequency welded pipe

Add this clause to the end of this paragraph:

EW Pipe produced with a welding current frequency equal to or greater than 100 KHZ. (Mod.)

6. PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe Grade and Steel Grade

6.1.4 Intermediate grades are not acceptable. (Add.)

7. INFORMATION TO BE SUPPLIED BY THE PURCHASER**7.1 General information**

Add this clause to the end of this item:

“i) minimum design temperature “ **(Mod.)**

7.2 Additional Information

a) The existing sub clauses a(1,2,9), b(5,8,11,12) and c(3,4,6) shall be deleted. **(Mod.)**

b) Add to the sub clauses in this item:

“17) The requirement for bevel protector”.

8. MANUFACTURING**8.1 Process of Manufacture**

Only PSL 2 pipe shall be supplied in accordance with this standard. **(Mod.)**

TABLE 2**(Mod.)**

Delete COW, COWL, COWH, Double-seam SAWL and Double-seam COWL.

Delete Footnotes a and d.

Note 1. COW may be acceptable only for making a continuous tack weld in SAW pipe.

Note 2. HFW pipe is generally limited to a maximum wall thickness 20 mm.

8.4 Tack Welds

8.4.1 e: shielded metal arc welding using low hydrogen electrodes from which the diffusible hydrogen content of the resulting weldment shall not exceed 10 ml/100g of deposited metal. **(Sub.)**

8.7 Weld Seams in Double-Seam Pipe**(Mod.)**

Add this clause to the end of this paragraph:

This type of pipe is not acceptable, unless specifically ordered by the purchaser.

8.9 Cold Sizing and Cold Expansion

8.9.2 The sizing ratio for cold-expanded pipe shall not be less than 0.008 or more than 0.015.

Note: Non-expanded SAW pipe shall not be supplied unless explicitly stated on the purchase order together with any supplementary test requirements. HFW and SAWH shall not be cold expanded. **(Sub.)**

8.10 Coil /plate end welds

8.10.3 Helical seam pipe with strip/plate end weld shall not be supplied. **(Sub.)**

8.11 Jointers

Jointers shall not be supplied. **(Sub.)**

8.14 Preparation of Edges for Welding **(Add.)**

The edges of the plates or strip to be welded shall be profiled by machining and at least 10 mm or 1.5 times the wall thickness, whichever is greater shall be removed from each side of the plate or strip either by machining or shearing. The abutting edges of the plate or strip shall be aligned for welding and adequate provision shall be made to ensure that the alignment is maintained during the progress of the welding operation and that any root gap is controlled within limits approved in the procedure test. All surfaces to be welded shall be thoroughly cleaned of scale, oil and other foreign matter before welding is started. The weld shall be of uniform width and profile and shall merge smoothly into the surface of the strip without appreciable deviation from the line of the joint. The forming procedure must ensure that there is a minimum of peaking and this shall be demonstrated in the procedure test to be within the acceptable limits defined in Par. 9.10.5 of this Standard.

9. ACCEPTANCE CRITERIA

9.2 Chemical Composition

9.2.2 For PSL 2 pipe with $t \leq 25.0$ mm (0.984 in), the chemical composition for standard grades shall be as given in Table 5. **(Sub.)**

The Manufacturer/Supplier's target product analysis shall be shown in the Manufacturing Procedure Specification. A single value target of $CE_{I\!W}$ or $CE_{P\!cm}$ shall be stated. The range of elements shall be such that the variation in the single value target $CE_{I\!W}$ does not exceed ± 0.03 units or $CE_{P\!cm}$ does not exceed ± 0.02 units with the following additional restrictions:

C	0.03 (HFW and SAW) 0.04 (SMLS)
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.

9.2.5 The Carbon equivalent for grade L415N or X60N and L555Q or X80Q of Seamless and welded pipes shall be as follows: **(Mod.)**

Steel grade (Steel name)	Carbon equivalent ^a % maximum	
	CE _{IW}	CE _{Pcm}
Seamless and welded pipes		
L415N or X60N	0.43	0.25
L555Q or X80Q	0.43	0.25

Change footnotes as follows:

Footnote a: Based upon product analysis. For seamless pipe with $t > 20.0$ mm (0.787 in), the carbon equivalent limits shall be 0.43. The CE_{IW} limits apply if the carbon mass fraction is greater than 0.12 % and the CE_{Pcm} limits apply if the carbon mass fraction is less than or equal to 0.12 %.

"Unless otherwise agreed," of footnotes c and g shall be deleted. **(Mod.)**

9.3 Tensile Properties

TABLE 7- REQUIREMENTS FOR THE RESULTS OF TENSILE TESTS FOR PSL 2 PIPE

For all grades maximum Ratio $R_{10.5} / R_m$ shall be changed to 0.9. **(Del.)**
 footnote g and all references to this footnote.

Add at the end of first sentence of footnote f "and not be less than 20%". **(Mod.)**

Delete footnote h and all references to this footnote.

9.8 CVN Impact Test for PSL 2 Pipe

9.8.1 General

9.8.1.2 Individual test values for any test piece shall be $\geq 80\%$ of the required minimum average (of a set of three test pieces) absorbed energy value. **(Sub.)**

9.8.2 Pipe body tests

9.8.2.1

The test temperature shall be lower than or equal to that specified in the table below. **(Mod.)**

Nominal Wall Thickness Wt (mm)	Test Temperature (°C)	Maximum Test Temperature (°C)
Wt ≤ 16.0	T(*)	0
16.0 < Wt ≤ 25	T-10	0
25 < Wt ≤ 32	T-20	0
	T-30	0

(*) T is the minimum design temperature, which shall be specified in the purchase order. If no minimum design temperature is indicated, it shall be taken as 0°C.

9.8.2.2 "If agreed" from the first line shall be deleted. **(Mod.)**

9.8.2.3 If 9.8.2.2 does not apply for the order item, for welded pipe with $\leq D$ 508 mm (20 in), the shear fracture area should be estimated and reported for information purposes, each sample shall exhibit not less than 50% fibrous shear. **(Sub.)**

9.8.3 Pipe weld and HAZ tests

The minimum average (of a set of three test pieces) absorbed energy for each pipe weld and HAZ test, based upon full-size test pieces and test temperature, shall be as follows: **(Sub.)**

Grade	Full-size CVN absorbed energy Minimum average value (of the set) J
	Pipe body, Weld and HAZ
L245 (B)	40
L290 (X42)	40
L320 (X46)	40
L360 (X52)	40
L390 (X56)	40
L415 (X60)	42
L450 (X65)	45
L485 (X70)	48
L555 (X80)	55

9.9 DWT test for PSL 2 welded pipe

9.9.1 Add at the end of first paragraph:

Full transition curves shall be established for one heat out of ten, with a minimum of one. **(Mod.)**

9.10 Surface conditions, imperfections and defects

9.10.6 Hard spots

Any hard spot larger than 50mm (2.0 in) in any direction shall be classified as a defect if its hardness exceeds 27 HRC, 275 HV10 or 260 HBW, based upon individual indentations. Pipes that contain such defects shall be treated in accordance with C.3 b (or C.3 c). **(Sub.)**

9.11 Dimensions, mass and tolerances

9.11.3 Tolerances for diameter, wall thickness, length and straightness

9.11.3.2 The tolerances for wall thickness shall be as given in Table 11.

TABLE 11 - TOLERANCES FOR WALL THICKNESS

Wall thickness <i>t</i> mm (in)	Tolerances mm (in)
SMLS pipe ^b	
≤ 4,0 (0.157)	+0,6 (0.024) -0,5 (0.020)
>4,0 (0.157) to <25,0 (0.984)	+0,150 <i>t</i>
≥25,0 (0.984)	±0.10 <i>t</i>
Welded pipe ^{c, d}	
≤5,0 (0.197)	±0,5 (0.020)
>5,0 (0.197) to < 10.0 (0.394)	+0.10 <i>t</i> -0.05 <i>t</i>
≥10.0 (0.394)	+0.10 <i>t</i> -0,5 (0.020)
<p>b For pipe with <i>D</i> ≥355,6 mm (14.000 in) and <i>t</i> ≥ 25,0 mm (0.984 in), the wall-thickness tolerance locally may exceed the plus tolerance for wall thickness by an additional 0,05 <i>t</i>, provided that the plus tolerance for mass (see 9.14) is not exceeded.</p> <p>c The plus tolerance for wall thickness does not apply to the weld area.</p> <p>d See 9.13.2 for additional restrictions.</p>	

(Sub.)

9.11.3.3

Delete sub clauses c, d and e. for 12m random length pipes (in table 12), minimum requirements shall be considered as follows:

Unless otherwise indicated in the purchase order the average length of pipes in one order shall be not less than 11.6 m with a minimum of 95% of pipes between 11 and 12.2 m in length. No pipe shall be less than 10 m in length. No pipe shall be greater than 12.8 m in length.

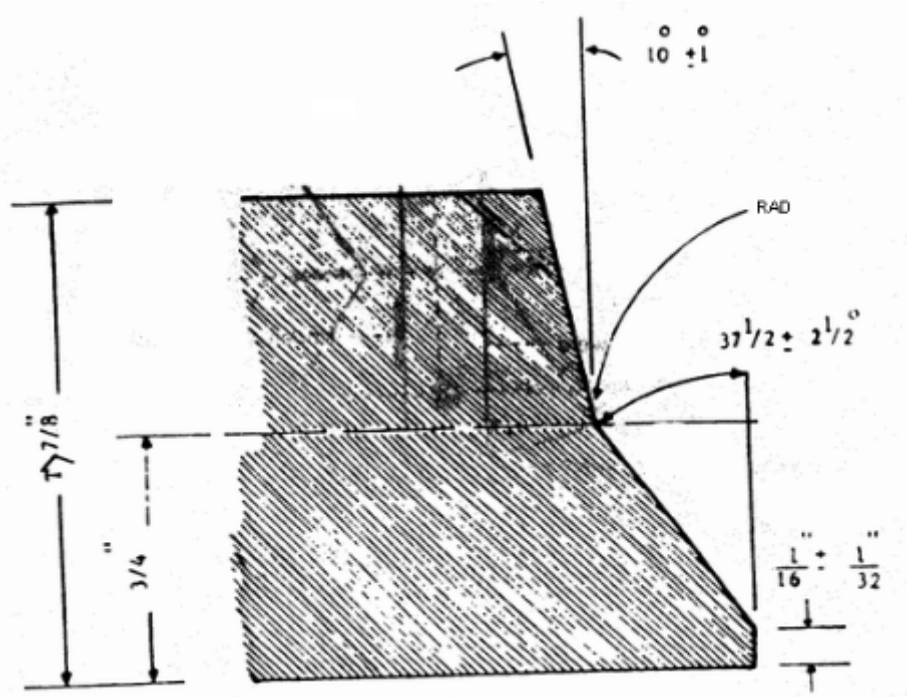
Note: For heavy wall seamless pipe, where supply of the pipe lengths stated above may not be possible, the Purchaser and the Manufacturer shall agree on an alternative pipe length.

(Mod.)

9.12 Finish of Pipe Ends

9.12.5 Plain ends

9.12.5.6 For wall thickness greater than 22 mm (7.8 in) the ends shall be beveled as shown in Fig. A of this supplementary. **(Add.)**



END PREPARATION FOR PIPE AND FITTINGS OVER 22 mm (7/8 in) THICKNESS

Fig. A

9.13 Tolerances for the Weld Seam

9.13.2 Height of the flash or weld bead/reinforcement

9.13.2.1 Change sub clauses b and d as follows:

b) The inside flash shall not extend above the contour of the pipe by more than 0.3 mm + 5% of nominal wall thickness.

d) The depth of groove resulting from trimming the internal flash shall not exceed the applicable value given in table15, provided that the remaining wall thickness is not less than allowed in clause 9.11.3.2 (Table11) of this standard. **(Mod.)**

9.13.2.2 "If agreed" from clause e shall be deleted. **(Mod.)**

**TABLE 16 - MAXIMUM PERMISSIBLE WELD BEAD HEIGHT FOR SAW AND COW PIPES
(EXCEPT AT PIPE ENDS)**

Specified wall thickness <i>t</i> mm (in)	Weld bead height ^a mm (in) maximum	
	Internal bead	External bead
≤13,0 (0.512)	2.5 (0.098)	3 (0.118)
>13,0 (0.512)	3 (0.118)	3 (0.118)
a At the option of the manufacturer, weld beads higher than permitted may be ground to acceptable heights.		

(Mod.)

10. Inspection

10.1 Types of inspection and inspection documents

10.1.3 Inspection documents for PSL 2 pipe

10.1.3.1 The manufacturer shall issue an Inspection Certificate 3.1.B in accordance with ISO 10474:1991. Alternatively, if specified in the purchase order, an Inspection Certificate 3.1.A or 3.1.C in accordance with ISO 10474:1991 or an Inspection Certificate 3.2 in accordance with EN 10204:2004 shall be issued.

(Sub.)

10.2 Specific inspection

10.2.1 Inspection frequency

10.2.1.2. For PSL 2 pipe, the inspection frequency shall be as given in Table 18 as following:

(Mod.)

TABLE 18 - INSPECTION FREQUENCY FOR PSL 2 PIPE

Type of inspection	Type of pipe	Frequency of inspection
Heat analysis	All pipe	One analysis per heat of steel
Product analysis	SMLS, HFW, SAWL, SAWH, COWL or COWH	Two analyses per heat of steel (taken from separate product items)
Tensile testing of the pipe body	SMLS, HFW, SAWL, SAWH, COWL or COWH	twice per test unit of pipe with the same cold-expansion ratio a
Tensile testing of the longitudinal or helical seam weld of welded pipe with DW 219,1 mm (8.625 in)	HFW, SAWL, SAWH, COWL or COWH	twice per test unit of pipe with the same cold-expansion ratio a,b,c
Tensile testing of the strip/plate end weld of welded pipe with D W 219,1 mm (8.625 in)	SAWH or COWH	twice per test unit of not more than 100 lengths of pipe with the same cold-expansion ratio a,b,d
CVN impact testing of the pipe body of pipe with specified outside diameter and specified wall thickness as given in Table 22	SMLS, HFW, SAWL, SAWH, COWL or COWH	As above
If agreed, CVN impact testing of the longitudinal seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	HFW	As above
CVN impact testing of the longitudinal or helical seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAWL, SAWH, COWL or COWH	As above
CVN impact testing of the strip/plate end weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAWH or COWH	As above
DWT testing of the pipe body of welded pipe with DW 508 mm (20.000 in)	HFW, SAWL, SAWH, COWL Or COWH	Once per test unit of pipe with the same cold-expansion ratio a
Guided-bend testing of the longitudinal or helical seam weld of welded pipe	SAWL, SAWH, COWL or COWH	Once per test unit of not more than 50 lengths of pipe with the same cold-expansion ratio
Guided-bend testing of the strip/plate end weld of welded pipe	Shall be deleted	
Flattening test of welded pipe	HFW	As shown in Figure 6
Hardness testing of hard spots in cold-formed welded pipe	HFW, SAWL, SAWH, COWL or COWH	Any hard spot exceeding 50 mm (2.0 in) in any direction
Hydrostatic testing	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
Macrographic testing of the longitudinal or helical seam weld of welded pipe	SAWL, SAWH, COWL or COWH	At least once per operating shift plus whenever any change of pipe size occurs during the operating shift; or, if 10.2.5.3

TABLE 18 – (continued)

		applies, at the beginning of the production of each combination of specified outside diameter and specified wall thickness
Metallographic testing (or optional hardness test in lieu of metallography) of the longitudinal seam weld of welded pipe	HFW	At least once per operating shift plus whenever changes of grade, specified outside diameter or specified wall thickness are made; plus whenever significant excursions from operating heat treatment conditions are encountered
Visual inspection	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe, except as allowed by 10.2.7.2
Pipe diameter and out-of-roundness	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
Out-of-squariness and straightness	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
Wall thickness measurement	All pipes	Each pipe (see 10.2.8.5)
Other dimensional testing	SMLS, HFW, SAWL, SAWH, COWL or COWH	Random testing, with the details left to the discretion of the manufacturer
Weighing of pipe with D < 141,3 mm (5.563 in)	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe or each lot, with the choice being at the discretion of the manufacturer
Weighing of pipe with D ≥ 141,3 mm (5.563 in)	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
Non-destructive inspection	SMLS, HFW, SAWL, SAWH, COWL or COWH	In accordance with Annex E
<p>a The cold-expansion ratio is designated by the manufacturer, and is derived using the designated before-expansion outside diameter or circumference and the after-expansion outside diameter or circumference. An increase or decrease in the cold-expansion ratio of more than 0,002 requires the creation of a new test unit.</p> <p>b In addition, pipe produced by each welding machine shall be tested at least once per week.</p> <p>e Test unit. is as defined in 4.49.</p>		

10.2.2 Samples and test pieces for product analysis

(Mod.)

The following paragraph shall be added to this Clause:

Samples shall be taken from finished pipe that means the pipe which has been formed and welded (if applicable) but before trimming to final pipe lengths.

10.2.3 Samples and test pieces for mechanical tests

TABLE 20 - NUMBER, ORIENTATION AND LOCATION OF TEST PIECES PER SAMPLE FOR MECHANICAL TESTS FOR PSL 2 PIPE

Change footnote c as follows:

Transverse test pieces shall be used.

10.2.5 Macrographic and metallographic test

10.2.5.2 Alternative methods are not acceptable. (Sub.)

10.2.5.3

For all pipe ordered for non- sour service hardness surveys (Vickers) shall be carried out as detailed in clause J.8.3.2 with the acceptance criteria specified in J.4.3. The frequency of testing shall be as required for impact testing by Table J.7. The requirements of Annex H shall apply to all pipe ordered for sour service. (Sub.)

10.2.6 Hydrostatic test

10.2.6.1 Each length of pipe shall withstand, without leakage, an inspection hydrostatic testing such that the hoop stress, calculated on the basis of the specified wall thickness and including stresses from end loading, is at least 95% of the specified minimum yield strength (SMYS). Hydrostatic testing shall be performed after cold expansion (if applicable). The test pressure for all sizes and types of pipe shall be held for not less than 10 seconds. (Sub.)

TABLE 26 - PERCENTAGE OF SPECIFIED MINIMUM YIELD STRENGTH FOR DETERMINATION OF S

This table shall be deleted. (Del.)

10.2.6.7 This clause shall be deleted. (Del.)

10.2.8 Dimensional testing

10.2.8.3 "If agreed" shall be deleted. (Mod.)

11. Marking**11.2 Pipe markings**

Add these sub clauses to the end of this clause as follows:

k) Heat number of pipe.

11.2.2.b Delete the phrase "unless a specific surface is specified in the purchase order"

11.2.2.b.1 Change "or" to "and" at the end of clause.

11.2.2.c On HFW pipe, the manufacture shall apply a 50 mm wide daub of heat resistant white paint on the inside surface at each end of each pipe to mark the location of the weld line. (Add.)

11.2.3 This clause shall be deleted. (Del.)

11.2.7 The following table shall be substituted with existing table.

(Mod.)

TABLE27- PAINT COLOR

Paint grade	Paint color
L 245 or B	Silver
L 290 or X42	Brown
L 320 or X46	Black
L 360 or X52	Green
L 390 or X56	Blue
L 415 or X60	Red
L 450 or X65	White
L 485 or X70	Purple-violet
L 555 or X80	Yellow

13. Retention of records

"If applicable" shall be deleted.

(Mod.)

ANNEXES**ANNEX A****SPECIFICATION FOR WELDED JOINTERS**

Note: This annex shall be deleted.

ANNEX B**MANUFACTURING PROCEDURE QUALIFICATION FOR PSL2 PIPE (Del.)**

B1. Delete all three sub-clauses and replace with the following:

Manufacturing procedure qualification shall be required for all PSL2 pipe unless otherwise stated by the Principal. Qualification shall be carried out on each combination of diameter and wall thickness supplied unless otherwise agreed with the Principal.

The qualified manufacturing procedure shall form the basis for pipe acceptance.

Deviation from the qualified manufacturing procedure shall require full re-qualification in accordance with the requirements of B.5. The Purchaser shall reserve the right to require requalification in the case of a change in the procedure specification.

The Manufacturer shall inform the Principal within 48 hours of any intentional or unintentional manufacturing deviations from the agreed procedures, dimensional tolerances or composition. Informing the Principal of these changes is essential to pipeline construction planning. The Manufacturer shall communicate these changes even if the finished line pipe meets the requirements of this standard.

B3. Add the following to list item B5:

For HFW pipe, the seam welding procedure shall also include details of the following:

- methods to be used for heating strip edges and for the control and monitoring of power input in relation to the temperature of the pipe surface and the speed of the pipe;
- Frequency (in kHz) of the welding power supply;
- Welding speed
- Welding Temperature
- Welding power
- Compressive force or displacement used in welding.
- Temperature of in-line normalizing (if applied)
- Details of any protective atmosphere used for welding;
- Methods used to accomplish and control the upset welding of the heated pipe edges;
- Methods used for trimming of the weld bead.

SAW pipe

- Plate manufacturing method including details of specialized cooling and heat treatment
- Plate NDT procedures
- Pipe forming procedure
- Seam welding procedure including details of the following:
 - Method of alignment, clamping and tack welding (if any) of the joints to be welded together with details of run-on and run-off tabs to be used and the method of their attachment to the pipe.
 - For pipe made by the cage-forming process, details of the methods used to maintain the alignment of the inside and outside welds
 - Welding process
 - Brand name, classification, size and grade of filler metal and flux

-
- Speed of welding
 - Number of electrodes and polarity for each electrode
 - Welding current for each wire
 - Welding voltage for each wire
 - Dimensions of welding preparation
 - Number of weld passes and their disposition
 - Details of tracking system for both inside and outside welding and also method for checking the set up of the system
 - Limits on internal and external weld reinforcement
 - Repair welding procedure
 - The method and degree of expansion to be applied
 - Pipe heat treatment procedure (when appropriate)
 - Hydrostatic test procedure
 - NDT procedure.

B5. Manufacturing procedure qualification tests

(Sub.)

B.5.1 General

Three of the completely finished pipes of the first day's production shall be selected at random for testing to verify that the submitted manufacturing procedure results in fully acceptable pipe. If more than one heat is used in the first day production pipes, at least two heats shall be represented by the tests pipes. At the Company discretion, the Company may make the selection. For orders of less than 50 tones, first day production tests are not required.

If the pipes have been made from coiled skelp, the pipes made from each end of the coil shall be tested in addition to the above pipes.

The pipes tested as above shall be considered to be test pipe(s) per heat or per shift as required by this Standard. The above first day production test shall be repeated after any change in the manufacturing procedure or interruption to the program. The Manufacturer shall submit to the Company a report giving the results of all tests indicated below together with macrographs of the weld cross section and micrographs confirming the microstructure of the plate and seamless pipe.

B.5.2 Visual Examination

All pipes shall be examined visually for dimensional tolerances and for surface defects in accordance with 9.11.

B.5.3 Non-Destructive Testing

B.5.3.1 UT

The weld seams of all pipes shall be examined by means of an automatic ultrasonic scanning device in accordance with Annex E or K and shall meet the requirements of Annex E or K. **(Add.)**

B.5.3.2 RT

The weld seams of all SAW pipes shall be radiographically examined throughout their full length in accordance with Annex E or K. **(Add.)**

B.5.3.3 PT or MT

The weld seams of all welded pipes greater than or equal to DN 600 (NPS 24) shall be subjected to PT or MT, throughout their full length both inside and outside, to check for longitudinal and transverse surface defects in the weld material.

For pipe less than DN 600 (NPS 24), the full length of the weld seam outside surface, plus the equivalent length of one pipe diameter each end of the internal surface, shall be examined. Seamless pipe shall also be subjected to PT or MT over the entire outside pipe body.

PT shall be in accordance with ASTM E165.

Acceptance of discontinuities shall be in accordance with Annex E or K Cracks are unacceptable and their causes shall be investigated. **(Add.)**

B.5.4 Physical Testing

The physical properties of all pipes shall be tested as specified below. Test results shall meet the requirements for the specified grade and type of pipe. **(Add.)**

B.5.4.1 Weld seam

The weld seam of all selected welded pipes shall be physically tested as required by relevant sections and annexes. For SAW pipe, in addition, an all-weld metal tensile test shall be made including the determination of tensile strength, yield strength and elongation. For determination of the elongation value, the "Oliver" formula, as specified in ISO 2566-1 may be used. Results of the all-weld metal tensile tests shall meet the minimum specified requirements of the plate, from which the pipe is made. For SAW pipe, in addition, weld impact tests shall be carried out in accordance with 9.8.

B.5.4.2 Pipe material

Tensile tests shall be carried out on the two pipes made from each end of a coiled skelp, or on two pipes made from different heats, as required by relevant sections except that for pipes greater than DN 200 (NPS 8) tensile tests shall be performed in both the transverse and longitudinal directions. **(Add.)**

B.5.4.3 Charpy impact test

Tests shall be carried out on all selected pipes in accordance with Section 9.8. In addition, full transition temperature curves shall be produced, showing impact energy (in Joules) and percentage shear (fibrous) of the fracture surface, plotted against temperature, over a temperature range sufficient to reproduce fracture acceptance from 10% to 100% fibrous shear.

B.5.4.4 Drop weight tear test

For pipe to be used in gas transmission lines, drop weight tear tests shall be carried out in accordance with Section 9.9.

B.5.4.5 HIC and SSC Tests

For pipe under sour services, HIC and SSC tests shall be performed as specified in Annex H.

B.5.5 Macrographic, Micrographic and Hardness Examination**B.5.5.1 SAW and HFW pipe**

For HFW pipe, a total of three specimen shall be taken from the selected pipes for microexamination, to provide proof that heat treatment of the weld zone has been adequate.

For SAW and HFW pipe, a series of Vickers hardness (HV 10) tests shall be made on one of the etched specimens selected by the Company. These series of readings shall extend from unaffected base metal on one side across the weld to unaffected base metal on the other side. Three traverses shall be made, one 2 mm from the outer edge, the second across the center and the third 2 mm from the inner edge. The spacing between the hardness impressions shall be 0.75 mm. The hardness impressions nearest the fusion line shall be within 0.5 mm of the fusion line.

B.5.5.2 Seamless pipe

Three specimens from one pipe shall be extracted from locations 120° apart from a position chosen by the Company, polished and etched for examination and checked for microstructure. A hardness survey shall be made on one of the above specimen selected by the Purchaser. Three traverses shall be made, one 2 mm from the outer edge, the second across the center and the third 2 mm from the inner edge. A minimum of 12 readings shall be taken at 5 mm intervals.

B.5.5.3 Acceptance criteria

No hardness measurement shall exceed 280 HV10. For pipes under non-sour conditions and 248 HV10 for pipes under sour conditions.

ANNEX C**TREATMENT OF SURFACE IMPERFECTIONS AND DEFECTS**

C.4.3 The total length of repaired zones on each pipe weld shall be $\leq 5\%$ of the total weld length for SAW and COW weld seams. For coil/plate end welds, the total length of the repaired zone shall not exceed 200 mm. **(Sub.)**

C.4.5 Weld repairs shall be performed using a welding procedure that is qualified in accordance with Annex D, by a welder qualified in accordance with Annex D.3. **(Sub.)**

ANNEX E

NON-DESTRUCTIVE INSPECTION FOR OTHER THAN SOUR SERVICE OR OFFSHORE SERVICE

E.3 Methods of Inspection

E.3.1 General

E.3.1.1 The following table shall be substituted with existing table. **(Mod.)**

TABLE E.1 - PIPE-WELD SEAM NON-DESTRUCTIVE INSPECTION

Weld seam type	Non-destructive inspection method a		
	Electromagnetic	Ultrasonic	Radiographic
HFV	not applicable	required	not applicable
SAW	not applicable	required ^b	If agreed
COW	not applicable	required	not applicable
Strip/Plate end	not applicable	required ^b	If agreed

a The weld seam at the pipe ends may require additional inspection (see E.3.2).
 b Required unless the manufacturer and the purchaser have agreed to replace it by radiographic inspection.

E.3.1.2 The following table shall be substituted with existing table. **(Mod.)**

TABLE E.2 - SMLS PIPE BODY NON-DESTRUCTIVE INSPECTION

Item	Wall thickness	Non-destructive inspection method a		
		Electromagnetic	Ultrasonic	Magnetic particle (circular field)
PSL 2 Pipe, any grade	t < 6 mm	one method or a combination of methods is required		not applicable
	t ≥ 6 mm	not applicable	required	not applicable

E.3.2 Pipe end inspection - Welded pipe

E.3.2.3 "If agreed" shall be deleted. **(Mod.)**

E.3.3 Pipe end inspection - SMLS pipe

E.3.3.2 "If agreed" shall be deleted. **(Mod.)**

E.8 Laminar imperfections in the pipe body of HFW, SAW, SMLS and COW pipes (Sub.)

E.8.1 Replace the first paragraph by the following:

For HFW pipe, ultrasonic inspection shall be used to verify that the pipe body is free of laminar imperfections greater than those permitted by **(Mod.)**

E.8.2 "If agreed" shall be deleted. **(Mod.)**

E.8.3 The body and ends of all seamless pipes shall be 100% ultrasonically tested for transverse, longitudinal and inclined embedded defects.

EMT may be applied for nominal wall thickness less than 6mm, according to table E.2. **(Add.)**

E.9 Laminar imperfections along the strip/plate edges or pipe weld seam of HFW, SAW and COW pipes (Mod.)

Replace the first paragraph by the following:

For HFW pipe, ultrasonic inspection shall be used to verify that the pipe body is free of laminar imperfections greater than those permitted by **(Mod.)**

ANNEX H
PSL 2 PIPE ORDERED FOR SOUR SERVICE

H.2 Additional information to be supplied by the purchaser

The existing clauses c, d, i and k shall be deleted. **(Mod.)**

H.3.2 Steel making

H.3.2.3 The molten steel shall be treated for inclusion shape control. A procedure (e.g. metallographic examination) shall be done to assess the effectiveness of inclusion shape control. **(Sub.)**

H.3.3.2 Welded pipe

H.3.3.2.1 "Unless otherwise agreed" shall be deleted. **(Mod.)**

H.3.3.2.4 "If agreed" shall be deleted. **(Mod.)**

H.3.3.2.5 Delete this clause. Strip/plate end welds are not permitted. **(Sub.)**

H.3.3.2.6 Intermittent tack welding of the SAWL groove shall not be used. **(Sub.)**

H.3.3.2.7 Unless otherwise specified by the Principal SAWH pipe shall not be used for sour service. **(Add.)**

H.3.3.3 Jointers

Jointers shall not be delivered. **(Sub.)**

H.4.1 Chemical composition

H.4.1.1 For pipe with $t \leq 35.0$ mm the chemical composition for standard grades shall be as given in Table H.1. The pipe designation shall be as given in Table H.1 and consists of an alpha or alphanumeric designation that identifies the grade, followed by a suffix that consists of a letter (N, Q or M) that identifies the delivery condition and a second letter (S) that identifies the service condition. **(Sub.)**

TABLE H.1 - CHEMICAL COMPOSITION FOR PIPE WITH $T \leq 35.0$ MM

Table H1 shall apply for all pipe grades and for pipe with $t \leq 35$ mm. The Manufacturer/Supplier's target product analysis shall be shown in the Manufacturing Procedure Specification. A single value target CE_{IIW} or CE_{PCM} , shall be stated. The range of elements shall be such that the variation in the single value target CE_{IIW} does not exceed ± 0.03 units or CE_{PCM} does not exceed ± 0.02 units with the following additional restrictions: **(Mod.)**

C	0.03 (HFW and SAW) 0.04 (SMLS)
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

No changes in the chemical composition (within the tolerances listed above) are permitted from the approved WPS composition. In particular no intentionally added elements shall be increased beyond the limits above or removed. The chemical composition recorded for the pipes used in first-day production testing shall set the datum CE. Where any of the above elements are not intentionally added, the manufacturer may propose maximum values for approval by the Principal. In this case the above ranges shall not apply. All elements listed in Table H1 shall be reported.

(Mod.)

TABLE H.2 - REQUIREMENTS FOR THE RESULTS OF TENSILE TESTS

For all grades maximum Ratio $R_{10.5}/R_m$ shall be change to 0.9,

Delete footnotes a, b and c of this table and also adding of this note at the end of footnote e:

Note: A_f shall not be less than 20%.

(Mod.)

H.4.4 Hardness test

The second paragraph shall be deleted.

(Mod.)

H.5 Surface conditions, imperfections and defects

H.5.2 For welded pipe hard spot shall be classified as a defect if its hardness, based upon individual indentations, exceeds 250 HV10, 22 HRC or 240 HBW. Pipes that contain such defects shall be treated in accordance with C.3 b) or C.3 c).

(Sub.)

H.7 Inspection

H.7.1 Specific inspection

Table H.3 - Inspection frequency

The following table shall be substituted with existing table.

(Mod.)

TABLE H.3 - INSPECTION FREQUENCY

Type of inspection	Type of pipe	Frequency of inspection
Hardness testing of pipe	SMLS, HFW, SAWL or SAWH	Two tests per test unit of pipe with the same cold expansion ratio (a). One test for heats less than 100 tone
Hardness testing of hard spots in welded pipe	HFW, SAWL or SAWH	Each hard spot found on the internal or external surface of the pipe
hardness testing of the longitudinal or helical-seam weld of welded pipe	HFW, SAWL or SAWH	Once per test unit of not more than 50 lengths of pipe with the same cold-expansion ratio Ra
Pipe diameter and out-of- roundness for pipe	SMLS, HFW, SAWL or SAWH	All pipe
Non-destructive inspection	SMLS, HFW, SAWL or SAWH	In accordance with Annex K
HIC test	SMLS, HFW, SAWL or SAWH	One test for each of the first three heats applied; thereafter, one test for each test unit of not more than ten heats of steel
SSC test	SMLS, HFW, SAWL or SAWH	One test for each pipe provided for manufacturing procedure qualification
<p>a Cold-expansion ratio is designated by the manufacturer and is derived using the designated before- expansion outside diameter or circumference and the after-expansion outside diameter or circumference. An increase or decrease in the cold-expansion ratio of more than 0,002 requires the creation of a new test unit.</p>		

H.7.2 Samples and test pieces for mechanical and technological tests

H.7.2.3 Samples and test pieces for SSC tests

H.7.2.3.2 Test pieces for four-point bending SSC tests shall be ≥ 115 mm (4.5 in) long 15 mm (0.59 in) wide 5 mm (0.20 in) thick. For welded pipe, the test piece shall contain the longitudinal or helical-seam weld in the middle of the tested area and the test piece shall be oriented transverse to the weld seam (Figure 5 b) & c) key 1). For seamless pipe, the sample shall be oriented longitudinal to the pipe body (Figure 5 a) key 1). If agreed, samples may be flattened. samples shall be machined from the inside surface of the pipe. **(Sub.)**

H.7.3 Test methods

H.7.3.1 HIC/SWC test

H.7.3.1.2 HIC/SWC tests shall be conducted in a medium complying with NACE TM0284:2003, Solution A. **(Mod.)**

H.7.3.1.3 This clause shall be deleted. **(Sub.)**

H.7.3.1.4 "If agreed" shall be deleted. **(Mod.)**

H.7.3.2 SSC test

H.7.3.2.1 "Except as allowed by H.7.3.2.2" shall be deleted. **(Mod.)**

H.7.3.2.2 This clause shall be deleted. **(Del.)**

ANNEX K**NON-DESTRUCTIVE INSPECTION FOR PIPE ORDERED FOR SOUR SERVICE AND/OR OFFSHORE SERVICE****K.2 General non-destructive inspection requirements and acceptance criteria**

K.2.1.4 If UT has not been performed from the outside and if UT from the inside is not feasible due to dimensional limitations, the end face/bevel at each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 13664 or ASTM E 709. Laminar imperfections 6.4mm (0.25 in) in the circumferential direction shall be classified as defects. **(Mod.)**

K.3.2 Laminar imperfections in the pipe body

The following table shall be substituted with existing table.

(Mod.)

TABLE K.1 – ACCEPTANCE CRITERIA FOR LAMINAR IMPERFECTIONS

Service condition	Maximum individual imperfection		Minimum imperfection size considered			Maximum population density ^a
	Area mm ² (in ²)	Length mm (in)	Area mm ² (in ²)	Length mm(in)	Width mm(in)	
Pipe body (or strip/plate body)						
Offshore	1000(1.6)	Not specified	300 (0.5)	35 (1.4)	8 (0.3)	10 [per 1,0 m (3.3 ft) 1,0m (3.3 ft) square] ^c
Sour	100 (0.16)		30 (0.05)	5 (0.2)	5 (0.2)	5 [per 500 mm(1.6 ft) 500 mm (1.6ft) square] ^c
Strip/plate edges or areas adjacent to the weld seam ^d						
Sour or offshore	100 (0.16)	20(0.8)	-	10(0.4)	-	3 [per 1,0m (3.3 ft)length]
<p>NOTE 1: For an imperfection to be larger than the minimum imperfection size, the minimum area, minimum length and minimum width given for the pipe body (or strip/plate body) all have to be exceeded.</p> <p>NOTE 2: For the purpose of determining the extent of suspect area, adjacent suspect areas separated by less than the smaller of two minor axes of the areas shall be considered one area.</p> <p>a Number of imperfection smaller than the maximum and greater than the minimum imperfection size.</p> <p>b For pipe with D <323,9 mm (12.375 in) or strip/plate widths less than 1 000 mm (39.4 in) , the maximum population density is referred to 1,0 m² (10.8 ft²).</p> <p>c For pipe with D < 168,3mm (6.625 in) or strip/plate widths less than 500 mm (19.7 in) , the maximum population density is referred to 0,25 m² (2.7 ft²).</p> <p>d The maximum imperfection area of edges is the product of the maximum imperfection length, where length is the dimension parallel to the material edge and the transverse dimension, An imperfection is considered to be larger than the maximum imperfection size if either the length or the transverse dimension is exceeded.</p>						

K.3.4 Supplementary non-destructive inspection

K.3.4.1 "if agreed" shall be deleted.

(Mod.)

K.4.2 Laminar imperfections in the pipe body

The pipe or strip/plate body shall be ultrasonically inspected for the detection of laminar imperfections in accordance with ISO 10893-8 (except 4.2) or ISO 10893-9, respectively, to acceptance limits for the relevant application as given in Table K.1. The coverage during automatic inspection shall be ≥ 100% of the pipe surface. **(Sub.)**

K.4.3 Laminar imperfections on the strip/plate edges or areas adjacent to the weld seam

The strip/plate edges or the areas adjacent to the weld seam shall be ultrasonically inspected over a width of 25 mm (1 in) for the detection of laminar imperfections, in accordance with ISO 10893-9 or ISO 10893-8, respectively, to the acceptance limits as given in Table K.1 for strip/plate edges or areas adjacent to the weld seam. **(Sub.)**

K.4.4 Supplementary non-destructive inspection

The pipe body of HFW pipe shall be inspected for the detection of longitudinal imperfections using the ultrasonic method in accordance with ISO 10893-10, acceptance level U2/C or ASTM E213. **(Sub.)**

K.5 Non-destructive inspection of SAW pipe**K.5.1 Ultrasonic inspection for longitudinal and transverse imperfections in seam welds**

K.5.1.1 Sub clause b shall be deleted and change the first paragraph of sub clause c as follows:

c) Manufacturer shall use acceptance level U2 internal and external notches, laying at right angles to, and centered over, the weld seam. In this case, both internal and external weld reinforcements shall be ground flush to match the pipe contour in the immediate area and on both sides of the reference notches. The notches shall be sufficiently separated from each other in the longitudinal direction and from any remaining reinforcement, to give clearly identifiable separate ultrasonic signal responses. The full signal amplitude from each of such notches shall be used to set the trigger/alarm level of the equipment. **(Mod.)**

K.5.2 Laminar imperfections in the pipe body and on the strip/plate edges

K.5.2.1 The pipe or strip/plate body shall be ultrasonically inspected for the detection of laminar imperfections in accordance with ISO 10893-9 to acceptance limits for the relevant service condition as given in Table K.1, with a coverage of ≥ 100 %.

K.5.2.2 The strip/plate edges, including those adjacent to the coil/plate end weld of helical-seam pipe, shall be ultrasonically inspected over a width of 25 mm (1 in) for the detection of laminar imperfections in accordance with ISO 10893-9 to acceptance limits as given in Table K.1 for strip/plate edges or areas adjacent to the weld seam. **(Sub.)**

K.5.3 Non-destructive inspection of the weld seam at the pipe ends/repared areas

Change footnotes a and b as follows:

a) For the detection of longitudinal imperfections, manual or semi-automatic ultrasonic inspection using the same inspection sensitivity and inspection parameters as is specified in K.5.1.1, and radiographic inspection in accordance with Clause E.4.

b) For the detection of transverse imperfections, a manual/semi-automatic ultrasonic inspection using the same inspection sensitivity and parameters as is specified in K.5.1.1 and a radiographic inspection in accordance with Clause E.4. **(Mod.)**