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	JOB: PROJETO DE DESENVOLVIMENTO INTEGRADO SERGIPE ÁGUAS PROFUNDAS		
	AREA: GASODUTO TERRESTRE		
SRGE	TITLE: SUPPLEMENTARY REQUIREMENTS TO API SPEC 5L		INTERNO
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REVISION INDEX

REV	DESCRIPTION AND/OR AFFECTED SHEETS
0	FIRST ISSUE
A	GENERAL REVISION
B	REVISED DUE TO CONSISTENCY CHECK

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
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INTRODUCTION

This Specification is supplementary to API Specification 5L (Line Pipe), 46th Edition, April 2018.

The paragraph sequence of this Specification follows the same order as API 5L.

Pipes shall be in accordance with API 5L, supplemented with alterations of this Specification, classified as follows:

[Addition]: insertion of a new requirement or continuation of that API 5L paragraph.
[Replacement]: replacement of part or its entirely of that affected API 5L paragraph.
[Deletion]: removal of that particular API 5L paragraph.

Paragraphs of API 5L not mentioned herein are considered fully applicable.

Requirements of this Specification prevail in case that occurs any divergence with API 5L.

1 Scope

1.1 Coverage

[Replacement] All pipes shall comply with product specification level PSL2.

1.2 Application of the API Monogram

[Addition] Pipes shall be supplied bearing the API Monogram in accordance with the requirements of Annex A.

8 Manufacturing

8.1 Process of Manufacture

[Addition] HFW, SAWH, COWL and COWH processes are not acceptable.

[Addition] SAWL pipes shall be cold expanded.

8.3 Starting Material

8.3.10 **[Addition]** In case of mixture of different steel grades in the continuous casting process, either the steel manufacturer or the pipe maker shall issue a chemical composition certificate of plate edge adjacent to the mixture in order to assure that this region is according to the specified grade.

8.11 Jointers

8.11.1 **[Replacement]** Jointers are not permitted.

8.14 [Addition] Manufacturing Procedure

All pipes shall be produced in accordance with a manufacturing procedure qualified according to Annex B.

9 Acceptance Criteria

9.2 Chemical Composition

9.2.2 **[Replacement]** The steel chemical composition shall be according to Table 5.

9.2.3 **[Replacement]** The chemical composition for pipe with t > 25.0 mm shall be according to 9.2.2 and Table 5.

9.2.6 **[Addition]** Analysis shall include all elements mentioned in Table 5 and any other alloying element added with the purpose to change steel properties.

[Replacement] Table 5. Chemical composition for PSL2 pipe.

Steel Grade	Mass Fraction (% max)									
	C	Mn	Si	P	S	V	Nb	Ti	CE	
									IIW	Pcm
B	0.18	1.20	0.30	0.020	0.010	0.05	0.05	0.04	0.38	0.19
X42	0.18	1.20	0.30	0.020	0.010	0.05	0.05	0.04	0.38	0.19
X46	0.16	1.30	0.30	0.020	0.010	0.05	0.05	0.04	0.38	0.19
X52	0.16	1.40	0.35	0.020	0.010	0.05	0.05	0.04	0.39	0.20
X56	0.16	1.40	0.35	0.020	0.010	0.06	0.05	0.04	0.41	0.22
X60	0.16	1.60	0.40	0.020	0.010	0.06	0.065	0.04	0.41	0.22
X65	0.16	1.60	0.40	0.020	0.010	0.07	0.065	0.05	0.42	0.22
X70	0.16	1.70	0.40	0.020	0.010	0.07	0.065	0.05	0.42	0.23
X80	0.10	1.70	0.30	0.020	0.005	0.04	0.08	0.03	-	0.19

a) For each reduction of 0.01% below the specified maximum for C, an increase of 0.05% above the specified maximum for Mn is permissible, up to a maximum of 1.50% for grades from B to X52; up to a maximum of 1.65% for grades from X56 to X65 and up to a maximum of 1.85% for grades X70 and X80.
b) $Al \leq 0.06\%$; $N \leq 0.012\%$; $Al/N \geq 2$.
c) $Nb+V+Ti \leq 0.15\%$; $Nb+V \leq 0.11\%$. For Gr. B, $Nb+V \leq 0.06\%$.
d) $Cu \leq 0.35\%$; $Ni \leq 0.30\%$; $Cr \leq 0.30\%$; $Mo \leq 0.15\%$; $B \leq 0.0005\%$ and $Cu+Cr+Mo+Ni \leq 0.70\%$.

9.3 Tensile Properties

9.3.2 **[Replacement]** In Table 7, replace "Ratio" column by: "The ratio of yield strength and ultimate tensile strength ($R_{t0.5}/R_m$), for all grades, shall not exceed 0.90."

[Deletion] Delete note "c" of Table 7. The ratio $R_{t0.5}/R_m$ shall be met for all pipe diameters.

9.8 CVN Impact Test for PSL2 Pipe

9.8.2 Pipe Body Tests

9.8.2.1 **[Replacement]** The minimum average (of a set of three test pieces) absorbed energy for each pipe body test shall be 248 Joules, based on full-size test pieces and a test temperature of -22 °C.

9.8.2.2 **[Replacement]** The average shear value of the fracture appearance of three specimens shall not be less than 85% and the minimum individual reading shall be 65%, based on a test temperature of -22 °C.

9.8.3 Pipe Weld and HAZ Tests

[Replacement] The minimum average (of a set of three test pieces) absorbed energy for each pipe weld and HAZ test, based on full-size test pieces and a test temperature of -22 °C, shall be 40 Joules.

9.9 DWT Test for PSL2 Welded Pipe

9.9.1 **[Addition]** For each test (of a set of two test pieces), the average shear fracture area shall be ≥ 85 %, based on a test temperature of -22 °C. The acceptance criteria for pipe with wall thickness > 25.4 mm shall be the same defined for pipes with wall thickness below 25.4 mm.

9.10 Surface Conditions, Imperfections and Defects

9.10.4 Laminations

[Addition] The acceptance criteria for laminations shall meet the requirements of E.3.2.3, E.8 and E.9 (for welded pipes) and E.3.3.2 (for SMLS pipes). Seamless pipes shall also meet the requirements of ISO 10893-8, acceptance level U3.

9.11 Dimensions, Mass and Tolerances

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

9.11.3.1 Table 10 – Tolerances for Diameter and Out-of-Roundness

[Addition] For D/t > 75, the out-of-roundness tolerances shall be the same used for D/t ≤ 75.

[Addition] The diameter and out-of-roundness tolerances for seamless pipes with wall thickness > 25 mm, shall be the same defined for pipes with wall thickness below 25 mm.

[Replacement] Replace in the last column (out-of-roundness tolerance for pipe end): "*0.01D, but maximum of 13 mm*" by "*0.01D, but maximum of 8 mm*".

9.11.3.3 **[Replacement]** The tolerances for length shall be as follows:

a) Minimum of 94% of pipes shall have length range from 11.50m to 12.50m, with a minimum average length of 12m.
b) Maximum of 6% of pipes should have length less than 11.50m, with a minimum length of 8.00m and a minimum average length of 10m.

9.12 Finish of Pipe Ends

9.12.5 Plain Ends

9.12.5.6 **[Addition]** The entire end bevel shall be machined and root faces shall not be brought into tolerance by filling or grinding. The manufacturer shall provide a proper bevel protection to avoid corrosion and damages during pipe handling and transportation.

9.13 Tolerances for the Weld Seam

9.13.2 Height of the Flash or Weld Bead / Reinforcement

9.13.2.2 [Replacement] e) The outside weld bead shall be removed by grinding for a distance of at least 150 mm from each pipe end. For SAWL pipes, it shall not extend above the adjacent pipe surface by more than 0.5 mm.

9.16 [Addition] Hardness Tests

The acceptance criteria shall be according to H.4.4.

10 Inspection

10.2 Specific Inspection

10.2.1 Inspection Frequency

10.2.1.2 [Addition] The following requirements shall be included in Table 18:

Line 13: The DWTT shall be performed.
Line 29: Hardness test shall be done at base metal and seam weld according to H.7.3.3 and Table H.3. For weld seam, it shall be done with the inspection frequency defined for pipe body.
Line 30: Metallographic examination for microstructure verification shall be carried out once for each test unit.

10.2.3 Samples and Test Pieces for Mechanical Tests

10.2.3.4 Test Pieces for the DWT Test

[Addition] If reduced thickness specimens are used, both surfaces shall be equally machined.

10.2.3.8 [Addition] Specimens for Hardness Test

The hardness test specimens shall be extracted according to H.7.2.4 and Table H.4.

10.2.4 Test Methods

10.2.4.8 Hardness Test

[Addition] Hardness test shall be done according to H.7.3.3.

10.2.5 Macrographic and Metallographic Tests

10.2.5.5 [Addition] For SAW pipes, the specimens for macrographic test shall be removed from both pipe ends.

10.2.5.6 **[Addition]** For SAW and SMLS pipes, the metallographic test shall be performed for microstructure verification.

10.2.6 Hydrostatic Test

10.2.6.2 **[Addition]** Verification against a master gage shall be performed before to the start of production. This verification shall also be done after sudden depressurization caused by hydrostatic failure of seals of test device or with change of wall thickness or grade.

10.2.6.5 **[Replacement]** Replace *"S is the hoop stress, expressed...as given in Table 26" by "S is the hoop stress equal to 95% of specified minimum yield strength"*.

10.2.6.6 **[Replacement]** Replace *"S is the hoop stress, expressed...(see Table 26)"* by *"S is the hoop stress equal to 95% of specified minimum yield strength"*.

10.2.10 Nondestructive Inspection

[Addition] All pipes shall be ultrasonically inspected on 100% of pipe surface. For SAW pipes, the inspection may be carried out on 100% of plate surface.

[Addition] For welded pipes, the ultrasonic inspection for laminations shall be also made in accordance with E.3.2.3, E.8 and E.9. For SMLS pipes, it shall be also performed in accordance with ISO 10893-8 and E.3.3.2.

11 Marking

11.2 Pipe Markings

11.2.1 **i) [Replacement]** Pipe identification number, heat number and purchase order number.

11.2.4 **[Replacement]** Die stamping is prohibited.

11.2.8 **[Addition**] Color identification on the inner surface shall be done in accordance with Table 27.

14 Pipe Loading

[Addition] Wood struts shall be installed at pipes ends with diameter/thickness ratio over 120, in order to provide protection against excessive out-of-roundness, during pipes storage and transportation.

Annex B
(Normative)

Manufacturing Procedure Qualification for PSL2 Pipe

B.1 Introduction

B.1.1 **[Replacement]** The manufacturing procedure qualification shall be done for each purchase order according to this annex.

B.1.3 **[Replacement]** The manufacturing procedure shall be qualified according to B.3, B.4 and B.5.

B.5 Manufacturing Procedure Qualification Tests

B.5.1 **[Addition]** The weld seam of SAW pipes shall be radiographically examined throughout their full length.

[Addition] A CVN impact transition curve shall be established for the line pipe base material. The CVN energy value at -22 °C shall meet the requirement of 9.8.2.1. One set of three specimens shall be tested at each of the following temperatures: 0, -20, -40, -60 and -80 °C. The results shall be documented in the qualification report. One transition curve shall be done for each pipe provided for manufacturing procedure qualification.

B.5.2 **[Replacement]** The frequency and amount of qualification testing shall be as follows:

a) The manufacturing procedure qualification tests shall be carried out at least in three randomly selected pipes for each combination of diameter and wall thickness. For each pipe, all tests specified by B.5.1 shall be done.
b) If more than one heat is used, at least two heats shall be tested.
c) Tests shall be repeated whenever there is a change in manufacturing procedures.
d) For welded pipes, the tests shall be repeated whenever the essential variables and supplementary essential variables are changed beyond the limits defined by ASME Section IX. If the changes are related only to the welding process, the required tests can be limited only to the seam weld.