



شرکت ملی گاز ایران

مدیریت پژوهش و فناوری

امور تدوین استانداردها

IGS

مشخصات فنی خرید

لوله های فولادی بدون درز/درزجوش گریدهای B تا X۸۰ , اندازه های ۶ تا ۵۶
اینچ

SMLS/HFW/SAWL/SAWH Carbon Steel Pipes, Grades B to
X80, Sizes : 6 to 56 inch.

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دفتر مدیر عامل

ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۶۹۱ مورخ ۱۳۹۵/۴/۲۷ هیأت مدیره، نامه شماره گ. ۰/۹۰۰/۵۴۳۸۹ مورخ ۹۵/۴/۲۳ مدیر پژوهش و فناوری در مورد تصویب نهایی استانداردهای زیر مطرح و مورد تصویب قرار گرفت.

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FOREWORD

This standard intends to be mainly used by NIGC and its contractors, and has been prepared based on interpretation of recognized standards and, technical document as well as employment of existing, knowledge, background and experience in natural gas industry at national and international level.

Iranian Gas Standards (IGS) are prepared, reviewed and amended by technical standard committees within NIGC Standardization Division and submitted to NIGC's "STANDARDS COUNCIL" for approval.

IGS Standards are subject to revision, amendment or withdrawal if required. Thus the latest edition of IGS shall be checked / inquired by NIGC employees and contractors.

This standard cannot be modified or altered by NIGC employees or its contractors.

Any deviation from normative references and / or well-known manufacturer's specifications must be reported to Standardization Division.

The technical standard committee welcomes comments and feedback about this standard, and may revise the document accordingly based on the received feedback.

GENERAL DEFINITIONS:

The following definitions, should be implied throughout this standard:

- 1- "STANDARDIZATION DIV." is responsible to deal with all aspects of standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.
- 2- "COMPANY": refers to National Iranian Gas Company (NIGC).
- 3- "SUPPLIER" refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.
- 4- "SHALL ": is used where a provision is mandatory.
- 5- "SHOULD": is used where a provision is advised only.
- 6- "MAY": is used where a provision is completely discretionary.

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1. Scope

(Sub.)

This specification is based on API 5L. 45th edition is written in the form of amendments and supplements of this standard, intended to be used for Non-sour service natural gas transmission and distribution pipeline applicable to grade B (L245) to $\leq$ X80(L555), from 6 to $\leq$ 56 inch sizes.

Note: *This specification supersedes IGS-M-PL-001-2(0):2013.*

1.1. Guidance for use of this specification:

The amendments/ supplements to API Spec. 5L. 45th edition given in this specification are directly equivalent sections or clauses in API 5L. All other paragraphs which are not amended by this supplementary shall remain valid as written. The following annotations, as specified hereunder, have been used at the beginning of each paragraph to indicate the type of change made to that paragraph of API 5L .

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

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

Add. (Addition) "The new paragraph 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 supplementary.

2. Conformity

2.3 Compliance to this standard

(Sub.)

The manufacturer shall establish and maintain a quality assurance system in accordance with the latest edition of ISO 9001 or an alternative standard approved by NIGC. Purchasers nominated inspector(s) or representative(s) shall have the right to undertake such audits as he/she deems necessary to assess the effectiveness of the manufacturer's quality assurance system.

3. Normative references (Del.)

ISO 13678, API 5B, API RP5A3, NACE TM0177 & NACE TM0284

(Add) The following standards:

ISO 9001: Quality systems-Model for quality assurance in design, development, production, installation and servicing.

ISO 9956-3: Specification and approval of welding procedures for metallic material part 3- welding procedure tests for the arc welding of steels.

ANSI/ASME B31.8: Gas Transmission and Distribution Piping Systems

API 1104: Welding of Pipelines and Related Facilities.

EN 876: Destructive Tests on weld in metallic materials Longitudinal Tensile Test on weld Metal in Fusion Welded joint

ANSI B 36.10 Welded and Seamless Wrought Steel Pipe.

ASTM E 112: Standard Test Methods for Determining Average Grain Size.

Shell DEP 31.40.20.37-Gen Line Pipe for Critical Service.

Saudi Aram Co 01-SAMSS-035 API Line Pipe.

IPS-M-PI-190(3) Material and Equipment Standard for Line Pipe.

4. Terms and definitions

(Del.) 4.8,4.9,4.10,4.11,4.12, 4.13, 4.20 ,4.30 ,4.33 ,4.34 ,4.35 ,4.52 .

4.23 HFW pipe

(Mod.)

EW pipe produced with a welding current frequency equal to or greater than 100 kHz.

4.53 SAWH pipe

(Mod.)

Tubular product having one Helical / Spiral seam produced by double submerged-arc welding

4.54 SAWL pipe

(Mod.)

Tubular product having one longitudinal / straight seam produced by double submerged-arc welding

4.57 Service condition

(Mod.)

The service condition is non-sour natural gas .Offshore and sour service is not included.

4.60 Tack weld

(Mod.)

Continuous seam weld used to maintain the alignment of the abutting edges until the final Seam weld is produced.

Tack weld shall be made by continuous single pass to complete the forming process.

4.67 welded pipe

(Mod.)

HFW, SAWH and SAWL pipe

5.Symbols and abbreviated terms

5.2 Abbreviated terms

(Add.)

AUT Automatic Ultrasonic Testing

IGS Iranian Gas Standard

NIGC National Iranian Gas Company

NPS: Nominal pipe size (inch)

6. Pipe grade, steel grade and delivery condition

6.1 pipe grade and steel grade

6.1.1(Sub.)

PSL1 shall not be supplied

6.1.2(Add)

Grades covered by this specification are B, X42, X46, X52, X56, X60, X65, X70 and X80.

Note2 (Del.)

Note 3(Del.)

6.2 Delivery condition

6.2.1 (Mod.)

Delivery condition for PSL 2 pipes are given in table 1 with additional information in table 3.

Table 1: (Add.)

Note: 1) PSL1 shall not be supplied

2) For welded pipes PSL2, only thermo mechanical rolled or hot rolled starting material shall be accepted.

7. Information to be supplied by the purchaser

7.1 General information

(Add.)

- i) Minimum design temperature for CVN test.
- j) Items which weld ability tests shall be carried out on.
- k) Special color code for wall thickness.
- l) Suitable bevel preparation for pipe line automatic field welding systems.
- m) The requiring or not requiring bevel protectors.

7.2 Additional information

(Del.) :a (9).b(3,5,8,13,14,15).c(2,4,5,6,7,13,14,18,19,25,31,44,50,55,56,57)

8 Manufacturing

8.1 Process of manufacture

Table 2

Notes **(sub)**

- a Only PSL2 are acceptable
- b Only HFW/SAWL/SAWH/SMLS pipes are acceptable
- c Pipe's grades are limited from B(L245) $\leq$ X80(L555)
- d HFW pipe's sizes are limited to NPS $\leq$ 20 (508).
- e SAWH pipes are limited to NPS $\geq$ 20(508).
- f SMLS pipes are limited from grade B(L245) to $\leq$ X60(L415).

8.3 Starting material

8.3.1

NOTE (Sub.) Raw material shall be procured from purchasers approved mill and shall have original certificate and third party inspection.

8.3.3 (Sub.)

For plate or coil, the steel shall be fully killed and fine grain with a grain size of 8 or finer, as defined in ASTM E-112.

8.3.7 (Add.)

The abutting edges of strip or plate to be welded shall be profiled by milling or machining.

8.4 Tack weld

8.4.2(Add.)

d) As defined in paragraph 4.60.

8.5(Del.) 9

8.7 (Sub.)

Double –seam pipe shall not be supplied.

8.8. Treatment of weld seam

8.8.1(Del.)

8.10 Coil / plate end welds

8.10.2(Mod.)

Finished helical seam pipe shall not contain any strip/plate end welds (skelp end weld).

8.10.3 & 8.10.4 (Del.)

8.11 jointers

8.11.1(Sub.)

Jointers shall not be supplied

8.11.2 & 8.11.3 & 8.11.4(Del.)

8.13 Traceability

8.13.1 (Sub.)

PSL1 pipe shall not be supplied

9. Acceptance criteria

9.2 Chemical composition

9.2.1(Del.)

9.2.3 (Mod)

For the pipes with $t > 25.0$ mm (0.984 in), the chemical composition shall be agreed, according to the requirements of Tables 5 and plate specification being amended as appropriate.

9.2.4 (Mod)

For pipe with a product analysis carbon mass fraction equal to or less than 0, 12 %, the Carbon equivalent, $CE_{PCM} \leq 0.21$, shall be determined using Equation (2).

9.2.5(Mod)

For pipe with a product analysis carbon mass fraction greater than 0, 12 %, the carbon Equivalent, $CE_{IIW} \leq 0.39$, shall be determined using Equation (3).

9.2.6 (Add.)

For HFW pipes, sulfur content shall not exceed 0.007%.

Table 4 (Del.)

Table 5 — Chemical composition for PSL 2 pipe with $t \leq 25, 0 \text{ mm (0.984 in)}$ (Mod)

Table 5 shall be modified accordant to paragraph: 9.2.4, 9.2.5 & 9.2.6.

9.3 Tensile properties

9.3.1 & Table 6 (Del.)

Table 6 (Del.)

Table 7 — Requirements for the results of tensile tests for PSL 2 pipe

9.3.2.1 (Mod)

- a- The ratio of body yield strength to body ultimate tensile strength shall not exceed:
- 0.88, for grade B.
 - 0.90, for grades X42 to $\leq$ X70.
 - 0.93, for grade X80.

- b- Max. Yield strength shall not exceed the min. values by more than 150 MPa.

9.4 Hydrostatic test

9.4.2 (Del)

9.6 Flattening test (Sub)

Acceptance criteria for flattening test of HFW pipe (all grades and all sizes) shall be as follows:

- 1) There shall be no opening of the weld before the distance between the plates is less than 50% of the original outside diameter.
- 2) There shall be no cracks or breaks other than in the weld before the distance between the plates is less than 33% of original outside diameter.
- 3) For all pipes, continue flatting until opposite walls of the pipe meet; no evidence of lamination or burnt metal shall develop during the entire test.

9.8 CVN impact test for PSL2 pipe

9.8.1.1 (Mod.) If sub size test pieces and orientations are used, the required minimum absorbed energy values shall be multiplied by the following corresponding factors:

Table par 9.8.1.1 (Add.)

SIZE (mm)	ORIENTATION	FACTOR
10 × 10	Longitudinal	1.5
10 × 7.5	Transverse	0.75
10 × 7.5	Longitudinal	1.125
10 × 5	Transverse	0.5
10 × 5	Longitudinal	0.75

9.8.1.2 (Mod.)

Individual test values for any test piece are given in table 8.

9.8.2.1(Mod.)

The minimum absorbed energy for pipe body, full size (10mm×10mm) specimen taken transverse to the pipe axis, is given in table 8. The test temperature shall be lower than or equal to that specified in the table below:

Table par. 9.8.2.1 (Add.)

Nominal Wall Thickness ,t mm(in)	Test Temperature (°C)
$W.t \leq 16$ (0.630)	T_{min}
$16(0.630) < w.t < 25$ (0.984)	$T_{min}-10$
$\geq 25(0.984)$	$T_{min}-20$
Note: T_{min} is the minimum design temperature which shall be specified in the purchase order. If no minimum design temperature is specified, it shall be taken -10°C .	

9.8.2.2 (Del)

9.8.2.3 (Mod.) The shear fracture area on the CVN specimen shall be estimated and reported for information purposes for all grades and sizes of pipe that have been CVN tested.

Table8 (Sub.)**Table 8- CVN absorbed energy requirement for pipe body**

Grade	Full –size CVN absorbed energy minimum	
	AV a set (J)	individual (J)
$B(L245) \leq X56(L390)$	40	32
X60(L415)	42	34
$X65(L450) \text{ to } \leq X70(L485)$	54	44
X80(L555)	68	55

9.8.3 Weld and HAZ tests**(Sub.)**

The minimum absorbed energy for each pipe weld and HAZ test shall be the 80% of those stated in Table 8.

If any individual specimen displays a value less than minimum in table 8, three further specimens shall be taken in the same area.

All three specimens shall comply with the minimum value.

9.9. DWT test for PSL2 welded pipe

9.9.1 (Sub.) For each test (a set of two test pieces) of NPS ≥ 16 , the average shear fracture area shall be $\geq 85\%$.

The test temperature shall be carried out at minimum design temperature specified in the purchase order. If no minimum design temperature is specified, it shall be taken -10°C .

9.10 Surface conditions, imperfections and defects

9.10.5.1 (Add) Flat spots and peaks at pipe ends that exceed 1,5 mm in depth, measured as the gap between the extreme point of the deviation, shall be considered defects.

9.10.5.2 a -(Sub.)

Any cold formed dents with sharp bottom gouge deeper than 1mm shall be considered as defect. Dents on weld &HAZ are not acceptable

9.10.6 Hard Spots (Mod)

Any hard spot larger than 50mm in any direction with hardness greater than 280 HV10 shall be classified as defect.

9.10.7 Other surface imperfections

d) (Add)

The minimum permissible wall thickness shall be classified by table 11 of API 5L (45th edition) standard.

9.11 Dimensions, mass and tolerances

Table 10(Mod.)

Table 10 – Tolerances for diameter and out of roundness

Specified outside diameter mm(in)	diameter tolerances ^d mm(in)				Out of roundness tolerances mm(in) ^b	
	Pipe except the end ^a		Pipe end ^{a, b}		Pipe except the end ^a	Pipe end ^{a, c}
	SMLS	Welded	SMLS	Welded		
168.3(6.625) to ≤610(24)	± 0.0075 D	± 0,007 5 D, but maximum of ± 3,2 (0.125)	± 0,005 D, but maximum of ±1,6 (0.063)		0.020 D	0.015 D but maximum 5.0(0.197) for any D/t
>610(24) to ≤1422(56)	±3.0 (0.118)	± 0,005 D, but maximum of ± 4,0 (0.160)	±2.0 (0.078)	±1.6 (0.063)	0.010 D but maximum of 13 (0.500) for any D/t	0.005 D for D/t ≤ 75 & 0.006 D for D/t >75

a) The pipe end includes a length of 100 mm (4.0 in) at each of the pipe extremities

b) Included in the diameter tolerance.

c) For out of roundness: The pipe ends with NPS ≤20 shall be checked for out of roundness by external ring gauges & for NPS ≥24 by internal ring gauges.

d) For determining compliance to diameter tolerances, the pipe diameter is defined as the circumference. of the pipe in any circumferential plane divided by Pi.

9.11.3.2 Tolerances for wall thickness shall be as given in table

11. Table 11 (Sub.)

Table 11- Tolerances for Wall Thickness

Wall thickness, t mm (in)	Minus tolerance mm(in)	Plus tolerance mm(in)
Welded pipe		
$t < 7.0(0.276)$	0.5(0.020)	0.5(0.020)
$7.0(0.276) < t < 10.0(0.394)$	5%t	10%t
$t \geq 10.0(0.394)$	0.5(0.020)	10%t but max. 1.5 mm
SMLS pipe		
All sizes, all grades,	10%t	12.5%t

9.11.3.3 and Table 12

(Sub)

The average length of pipes in one order shall not be less than 11.6m with a minimum of 95 % of pipes between 11m to 12.2 m in length. No pipe shall be less than 5m for NPS≤20 and 8m for NPS≥24 in length. No pipe shall be more than 12.5m.

9.11.3.4(Mod.)

a) The total Deviation from a straight line, over the entire pipe length, shall be less than 0.15 percent of pipe length.

9.12 Finish of pipe ends

9.12.1.1 (Del.)

9.12.2 Threaded ends (PSL1 only) (Del.)

9.12.3 Belled ends (PSL1 only) (Del.)

9.12.4 End preparation for special coupling (PSL1 only) (Del.)

9.12.5 Plain end

9.12.5.2(Mod.)

The end face of each pipe with wall thickness $0.125(\text{in}) \leq 0.875(\text{in})$, shall be beveled for welding the angle of the bevel, measured from a line drawn perpendicular to the axis of the pipe shall be 30 degrees with tolerance of + 5, - 0 and the width of the root face of the bevel shall be 1.6mm, with a tolerance of $\pm 0.8\text{mm}$.

9.12.5.3 (Mod)

For wall thickness greater than 0.875(in), the ends shall be beveled as shown in Fig.1 of Appendix 2

For field mechanized / automatic girth welding, other end preparation may be specified

in the purchase order.

Table 13 (Del.)**9.13 Tolerances for the weld seam****9.13.2.2 e (Mod.)**

For a distance of at least 150mm (6.0 in) from each pipe ends, the outside weld bead shall be removed by grinding

9.13.2.2 f (Add.)

The height of outside weld beads shall not exceed 3 mm.

9.15 Weld ability of PSL2 pipe**(Sub.)**

If specified in purchase order, weld ability trials shall be carried out to approve the WPS of girth welding which agreed between NIGC and manufacturer. The test pieces shall be inspected and tested as per API 1104(CVN test is required).

9.16 Macro residual stress test**(Add.)**

Spiral welded pipe (SAWH) shall meet the testing and minimum acceptance criterion as per 9.16.3 The residual stress test shall be done after the hydrostatic test.

9.16.1 Test Frequency

For first day production, one specimen shall be tested for each grade, size and wall thickness. For during Production once per test unit

9.16.2 Test Specimen

The specimen consists of a 150 mm wide ring cut from the end of a pipe (see the figure 7 of Appendix 2). The specimen may be either flame cut or sawed from the parent pipe. The specimen ring shall be cut, by flame or sawing, parallel to the longitudinal axis. The cut shall be 180 degrees from the spiral weld. Prior to cutting the ring, fiducially marks shall be placed on either side of the proposed cut location.

9.16.3 Computation of Macro Residual Stress

The change in circumference after cutting shall be measured using the fiducially marks established on the specimen prior to severing. The assumed residual stress shall be computed using the following formula:

$$S = \frac{ETC}{12.566 R^2}$$

Where:

S residual stress in MPa (psi)

C ± change in circumference, mm (in)

t nominal thickness, mm (in)

E 200,000 MPa (2.9×10^7 psi)

R = nominal pipe radius mm (in)

9.16.4 Acceptance Criterion

The computed macro residual stress shall not exceed ±10% of the specified minimum yield strength of the material.