

# Gasunie Technical Standard

Material Specification Mechanical

MSW-01-E

## **Pipe for gas lines**

*Seamless and welded line pipe*

*External*

Version 12 13-10-2021

# N.V. Nederlandse Gasunie

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Material Specification Mechanical  
MSW-01-E

### **Pipe for gas lines** *Seamless and welded line pipe*

This specification is drawn up by the Gasunie department  
"VGM Advisering" (HSE Consultancy).

Issued by Gasunie department "Document Support".

## FOREWORD

This specification supersedes the eleventh version of MSW-01-E.

With respect to the former version the following has been changed:

- Reference to [NEN-EN-ISO 3183](#):2019 and [API SPEC 5L](#):2018;
- Scope change to include nitrogen gas and hydrogen gas;
- Adoption of new fracture arrest criteria;
- Adoption of L290ME/NE and L360 ME/NE for Gasunie Deutschland;
- Requirements for the samples of the product analysis;
- Reduction of the maximum tensile strength of L360ME/NE, L415ME and L485ME;
- Requirements for the notch position of CVN test piece of the HFI bond line.

For further information, reference is made to documentation 1.

Alterations are marked with a left margin line.

This specification is to be read in conjunction with the international standard [NEN-EN-ISO 3183](#):2019 and [API SPEC 5L](#): 2018.

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## 1. SCOPE AND APPLICATION

This standard specifies the requirements for line pipe of grades given in table 1 for use in natural gas, methane, hydrogen, nitrogen pipelines and piping systems with a maximum operating pressure of 80 bar (e) and a temperature from -20 °C up to and including +50 °C. The allowed pipe type and steel quality is given in table 1.

Table 1 Allowed pipe type and steel quality per diameter

Diameter	Seamless	HFI	SAWL	SAWH (excluding stations)
$100 \leq DN \leq 500$	L245NE L290NE L360NE	L245ME/NE L290ME/NE L360ME/NE L415ME	L245ME/NE L290ME/NE L360ME/NE L415ME L485ME	not allowed
$500 < DN \leq 1200$	not allowed	not allowed	L415ME L485ME	L415ME L485ME

## 2. REFERENCES

This specification is subject to the requirements of the documents mentioned in this clause. If the documents in this specification are mentioned with a date, this specific edition is applicable.

### 2.1 Gasunie specification

Reference is made in this specification to the following Gasunie specification:

[MSA-32-E](#)

Requirements for inspection certificates of pressure parts.

### 2.2 Standards

Reference is made in this specification to the standards<sup>1</sup> mentioned in this subclause. Any supplements and errata notices are also applicable.

API SPEC 5L  
(April 2018)

Line Pipe.

NEN-EN-ISO 3183  
(November 2019)

Petroleum and natural gas industries - Steel pipe for pipeline transportation systems.

NEN-EN-ISO 14284

Steel and iron - Sampling and preparation of samples for the determination of chemical composition.

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<sup>1</sup> Applicable for all NEN-EN standards: Depending on the country where the standard will be applied, DIN-EN or BS-EN, for example, shall be chosen.

### 3. DEFINITIONS, ABBREVIATIONS AND SYMBOLS

#### 3.1 Definitions

In this specification the following definitions are applicable:

Client	The person or persons who is/are responsible, on behalf of Gasunie, for supervising the fulfilment of the contract in general and the execution of the work in particular.
Coil end weld	Weld that joins coil ends together in SAWH pipe <sup>2</sup> .
HFI	High frequency electric induction welding, a type of high-frequency electric welding (HFW)
HFI pipe	Tubular product is manufactured by forming from strip and welding the abutting edges without addition of filler metal. The longitudinal seam is generated by the HFI process.
Peak	Local out-of-roundness (figure 10) that occurs as a result of the pipe forming process or manufacturing operations.
Product analysis	Chemical composition of the pipe.
SAW pipe	Tubular product having one longitudinal seam (SAWL pipe), or a helical seam (SAWH pipe), produced by the submerged-arc welding process (SAW).

#### 3.2 Abbreviations

In this specification the following abbreviations are applicable:

AWT	All Weld Tensile
CVN	Charpy V-notch
HFI	High Frequency Induction
HV 10	Vickers hardness with an indentation load of 10 kg
SAW	Submerged Arc-Welded
SAWH	Helically Submerged Arc-Welded
SAWL	Longitudinally Submerged Arc-Welded
SMLS	Seamless

#### 3.3 Symbols

In this specification the following symbols are applicable:

<u>Symbol</u>	<u>Description</u>	<u>Unit</u>
$A_f$	elongation after fracture	%
$D$	specified outside diameter of the pipe	mm
$e$	peak depth (figure 10)	mm
$K_v$	impact energy	J
$R_m$	tensile strength	MPa
$R_{t0,5}$	yield strength (0,5 % total extension)	MPa
$t$	specified wall thickness of the pipe	mm

<sup>2</sup>

In previous versions of this specification (MSW-01-E) the term "strip end weld" was used.

## 4. AMENDMENTS/SUPPLEMENTS TO [API SPEC 5L](#)

### 4.1 General requirements

Seamless and welded line pipe shall be conform [API SPEC 5L](#), Annex A of [NEN-EN-ISO 3183](#) and the modifications and supplements given in this specification (MSW-01-E).

Any reference to PSL 1 line pipe given in [API SPEC 5L](#) is inapplicable.

Sections not mentioned remain unaltered.

Additional requirements, which are not stated in [API SPEC 5L](#), are indicated with "addition".

Sections of [API SPEC 5L](#), which are not valid, are indicated with "deletion".

Requirements which are stated in [API SPEC 5L](#), that shall be replaced, are indicated with "substitution".

Gasunie choices are indicated as "choice".

The numberings and (sub)clauses in italics in this specification correspond to that in [API SPEC 5L](#), where the subject is covered by that specification and any additional (sub)clauses are numbered sequentially.

### 4.2 Modifications and supplements to [API SPEC 5L](#)

#### SECTION 9 ACCEPTANCE CRITERIA

##### **9.7 Guided-bend test**

Addition 9.7.3  
The test pieces of the helical seam and coil end weld shall not fracture nor reveal any cracks.

Substitution **9.9 DWT test for PSL 2 pipe**  
(Subclause title is modified)

Substitution 9.9.1  
Substitute the first sentence:  
For each test (of a set of two test pieces), the average shear fracture area shall be  $\geq 85\%$ , based upon a test temperature of 0 °C. Only full fractured test pieces are allowed.

##### **9.10 SURFACE CONDITIONS, IMPERFECTIONS AND DEFECTS**

Substitution 9.10.1 General  
9.10.1.2  
All pipes shall be free from cracks, sweats, leaks, slivers, dents and gouges.



### 9.10.5 Geometric deviations

Substitution

#### 9.10.5.1

For other than dents, geometric deviations from the normal cylindrical contour of the pipe (e.g. flat spots and peaks, see figure 10 of this specification MSW-01-E) that occur as a result of the pipe forming process or manufacturing operations and that exceed  $0,003 D$  with a maximum of 2,5 mm in depth, measured as the gap between the extreme point of the deviation and the prolongation of the normal contour of the pipe, shall be considered defects and shall be treated in accordance with C.3 b) or C.3 c).

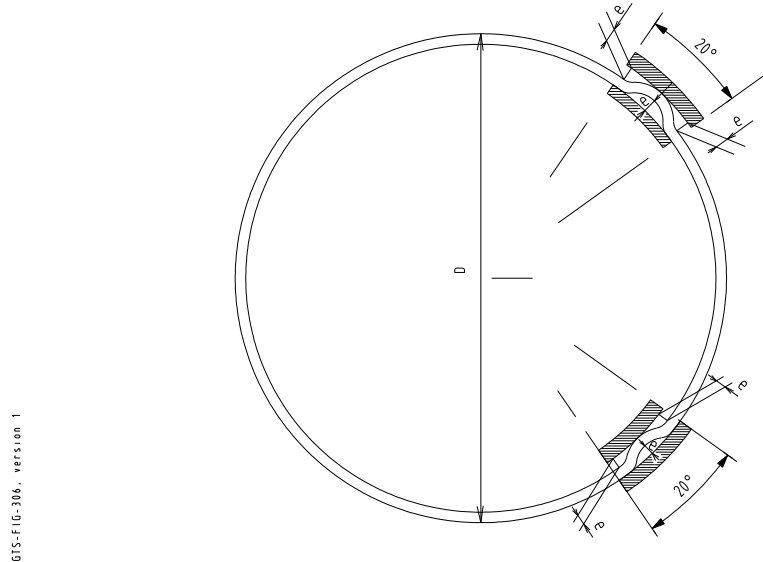


Figure 10 — Local out-of-roundness (peak):

$e \leq 0,003 D$  with a maximum of 2,5 mm

Substitution

#### 9.10.5.2

For dents, the length in any direction shall be  $\leq 0,5 D$  and the depth, measured as the gap between the extreme point of the dent and the prolongation of the normal contour of the pipe, shall not exceed  $0,04 D$  with a maximum of the 6,0 mm.

Dents that exceed the specified limits shall be considered defects and shall be treated in accordance with C.3 b) or C.3 c).

Addition

#### 9.10.5.3

The depth of geometric deviations within 100 mm from the pipe ends shall not exceed 2 mm. The length in any direction shall be  $\leq 0,3 D$ .

Substitution

#### 9.10.7 Other surface imperfections

Other surface imperfections found by visual inspection shall be investigated, classified and treated as follows:

- Imperfections that have a depth  $\leq 0,05 t$  and do not encroach on the minimum permissible wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1.
- Imperfections that have a depth  $> 0,05 t$  and  $\leq 0,125 t$ , provided the length and the width are within 7 % of the circumference and do not encroach on the minimum permissible wall thickness shall be classified as defects, and shall be dressed-out by grinding in accordance with Clause C.2 or shall be treated in accordance with Clause C.3.
- Imperfections that have a depth  $> 0,125 t$  or imperfections that encroach on the minimum permissible wall thickness shall be classified as defects and shall be treated in accordance with Clause C.3.

**Note**

"Imperfections that encroach on the minimum permissible wall thickness" implies that the portion of the wall thickness that is beneath the surface imperfection is less than the minimum permissible wall thickness.

**9.11 Dimensions, mass and tolerances****9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness****9.11.3.3**

Tolerances for length shall be as follows:

Substitution a) Random lengths shall be delivered within the tolerances given in Table 12 of this specification (MSW-01-E).

Substitution Table 12 Tolerances for random length groups

Length group	Length range for 90 % of order item <sup>a</sup>	Minimum average length for order item	Shortest length for order item
	m	m	m
r1	6 to 11	8	4
r2	9 to 14	11	6
r3	10 to 16	12	7
r4	11 to 18	15	8
a The upper limit applies as an absolute maximum value for the length of each individual pipe.			

**9.12 Finish of pipe ends****9.12.5 Plain ends**

Substitution 9.12.5.2

The end faces of plain-end pipe with  $3,2 \text{ mm} < t \leq 20 \text{ mm}$  shall be bevelled for welding. The angle of the bevel, measured from a line drawn perpendicular to the axis of the pipe, shall be  $30^\circ$  with a tolerance of  $+5^\circ / -0^\circ$ , and the width of the root face of the bevel shall be 1,6 mm, with a tolerance of  $\pm 0,8 \text{ mm}$ .

The end faces of plain-end pipe with  $t > 20 \text{ mm}$  shall be bevelled for welding. The angle of the bevel, measured from a line drawn perpendicular to the axis of the pipe, shall be  $27,5^\circ$  with a tolerance of  $+5^\circ / -0^\circ$ , and the width of the root face of the bevel shall be 1,6 mm, with a tolerance of  $\pm 0,8 \text{ mm}$ .

**9.13 Tolerances for the weld seam****9.13.2 Height of the flash or weld bead/reinforcement**

Modification 9.13.2.1 For HFI pipe the following shall apply

Substitution d) The depth of groove resulting from trimming the internal flash shall not exceed 0,05 t.

Modification 9.13.2.2 For SAW pipe the following shall apply

Substitution b) Weld beads shall blend in smoothly with the adjacent pipe surface. The inside weld toe angle of SAWH pipe shall be at least  $100^\circ$ .

Substitution e) For a distance of at least 250 mm from each pipe end, the outside weld bead shall be removed by grinding such that it does not extend above the adjacent pipe surface by more than 0,5 mm.

**SECTION 10 INSPECTION****10.2 Specific inspection**

Substitution *10.2.2 Samples and test pieces for product analysis*  
Samples shall be taken, and test piece prepared in accordance with [NEN-EN-ISO 14284](#). At least one sample shall be taken from the pipe.

*10.2.4 Test methods**10.2.4.4 Drop weight tear test*

Addition In case the shear area is difficult to determine with the unaided eye, i.e. in case of splits and/or separations, the percentage shear area shall be determined with a method that can determine the fracture type of splits and/or separations at the discretion of the manufacturer.

*10.2.5 Macrographic and metallographic tests**10.2.5.3*

Substitution Substitute the last paragraph with:  
A Vickers hardness test is required. The difference in hardness values between the weld and the coil material shall be less than 80 HV 10 units.

*10.2.12 Retesting*

Addition If any specimen fails to meet the specified requirements, the reason shall be determined and retesting may be carried out. The failure analysis shall be submitted to Client for approval.

**SECTION 11 MARKING****11.2 Pipe markings**

Addition *11.2.1* k) purchase order number;  
l) pipe number.

Substitution *11.2.3*  
The required markings shall be applied by low-stress die-stamping and placed on the outside pipe surface between 20 mm and 150 mm from one pipe end and at least 25 mm from any weld. The height of the markings shall be at least 4 mm and the minimum impression shall be 0,2 mm. The die-stamped marks shall be placed within a frame of white paint (weld primer).

**ANNEXES [API SPEC 5L](#)****B MANUFACTURING PROCEDURE QUALIFICATION FOR PSL 2 PIPE ([API SPEC 5L](#))*****B.1 Introduction***Substitution *B.1.3*

Verification of the manufacturing procedure shall be by qualification in accordance with Clause B.3, B.4, and B.5.

Addition *B.1.4*

Welding machine operators shall be qualified in accordance with D.3.

***B.3 Characteristics of the manufacturing procedure specification***

Deletion In the first sentence:

"or at the manufacturer's risk from the initial production run,"

***B.4 Characteristics of the inspection and test plan***

Addition

The inspection and test plan shall be approved by Client department "HSE - Verification & Inspection" before production can commence. The inspection and test plan shall include references to the sections of MSW-01-E (this specification) and/or [NEN-EN-ISO 3183](#) and internal procedures for each activity.

***B.5 Manufacturing procedure qualification tests***Substitution *B.5.1*

For the qualification of the manufacturing procedure, the mandatory tests specified in Table A.7 of this specification (MSW-01-E) shall be carried out prior to the production. The tests shall not be older than three years.

**C**      **TREATMENT OF SURFACE IMPERFECTIONS AND DEFECTS**  
**([API SPEC 5L](#))**

***C.1 Treatment of surface imperfections***

Addition      Surface and weld geometry imperfections that may adversely affect any subsequent coating operation shall be dressed-out.

## **G PSL 2 PIPE WITH RESISTANCE TO DUCTILE FRACTURE PROPAGATION ([API SPEC 5L](#))**

Modification *G.7.2 EPRG Guidelines - Approach 1*

Substitution Table G.2: Minimum CVN absorbed energy requirements for a design factor of  $\leq 0.72$

Specified outside diameter mm	Full-size CVN absorbed energy, min				
	K <sub>v</sub> J				
	Pipe Grade				
	L245	L290	L360	L415	L485
$\leq 508$	40	40	50	60	80
$> 508$ to $\leq 610$	40	40	50	60	80
$> 610$ to $\leq 711$	40	40	50	70	90
$> 711$ to $\leq 813$	40	40	60	70	100
$> 813$ to $\leq 914$	40	40	60	80	110
$> 914$ to $\leq 1016$	40	50	60	80	120
$> 1016$ to $\leq 1118$	40	50	70	90	130
$> 1118$ to $\leq 1219$	40	50	70	90	140

**ANNEX A [NEN-EN-ISO 3183](#)**

Seamless and welded line pipe shall be conform Annex A of [NEN-EN-ISO 3183](#) and modifications and supplements as listed below.

**A**      **PSL 2 PIPE ORDERED FOR EUROPEAN ONSHORE  
NATURAL GAS TRANSMISSION PIPELINES  
([NEN-EN-ISO 3183](#))**

**A.3 MANUFACTURING**Substitution    *A.3.1 Manufacturing procedure*

The pipe manufacturer shall operate a quality system. The quality system shall be approved by Client.

The manufacturing procedure shall be qualified in accordance with Annex B of [API SPEC 5L](#) and this specification (MSW-01-E).

Substitution    *A.3.3.2.3*

For helical seam pipe made from coil, pipe containing coil end welds may be delivered, provided that such welds:

- are located at least 300 mm from the pipe end, and
- have been subjected to the inspection regime in A.7.2 of this specification (MSW-01-E).

**A.4 ACCEPTANCE CRITERIA***A.4.1 Chemical composition*Addition        *A.4.1.3*

The product analysis shall be in accordance with Table A.1 and [MSA-32-E](#).

*A.4.2 Tensile properties*Substitution    *A.4.2.1*

The tensile properties of the pipe body and the longitudinal seam shall be as given in Table A.2 of this specification (MSW-01-E). For pipe with  $t > 25,0$  mm up to 40 mm, the tensile properties shall be as agreed, with the requirements given in Table A.2 of this specification being amended as appropriate.

Substitution Table A.2 Requirements for the results of tensile test of the pipe body and the longitudinal seam  $t \leq 25,0$  mm

Steel grade	Pipe body of SMLS and welded pipes						Weld seam of HFI and SAWL pipes
	Yield strength		Tensile strength		Ratio	Elongation <sup>a</sup>	Tensile strength
	$R_{t0,5}$ MPa		$R_m$ MPa		$R_{t0,5}/R_m$	$A_f$ %	$R_m$ MPa
	minimum	maximum	minimum	maximum	maximum	minimum	minimum
L245ME/L245NE	245	440	415	655	0,85	22	415
L290ME/L290NE	290	440	415	655	0,85	22	415
L360ME/L360NE	360	510	460	700	0,85	20	460
L415ME	415	535	550	700	0,85	18	550
L485ME	485	580	600	700	0,90	18	600

<sup>a</sup> These values apply to transverse test pieces taken from the pipe body. When longitudinal test pieces are tested (see Table 20 of [API SPEC 5L](#)), the values of elongation shall be 2 units higher.

Addition	<p><b>A.4.2.2</b></p> <p>The tensile properties of the helical seam and coil end weld shall be as given in Table A.2a of this specification (MSW-01-E). For pipe with <math>t &gt; 25,0</math> mm up to 40 mm, the tensile properties shall be as agreed, with the requirements given in Table A.2a of this specification (MSW-01-E) being amended as appropriate.</p>
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Addition      Table A.2a    Requirements for the results of tensile test of the helical seam  
and coil end weld  $t \leq 25,0$  mm

Steel grade	All weld tensile test				Transverse tensile test <sup>a</sup>	
	Yield strength	Tensile strength	Ratio	Elongation	Tensile strength	Fracture location
	$R_{t0,5}$ MPa minimum	$R_m$ MPa minimum	$R_{t0,5}/R_m$  maximum	$A_f$ % minimum	$R_m$ MPa minimum	
L415ME	468	577	0,90	16	550	base material
					577	base material or weld
L485ME	540	630	0,90	16	600	base material
					630	base material or weld

<sup>a</sup> Location "W" transverse weld sample, centred on the helical seam, location "WS" for the coil end weld see Figure 5c.



**A.4.4 CVN impact test****A.4.4.1 Pipe body**

Substitution the first paragraph with:

The minimum average (set of three test pieces) absorbed energy for the pipe body, based upon full-size test pieces, shall be in accordance with Table G.2 of this specification (MSW-01-E). Single values of the absorbed energy shall be at minimum 75 % of the minimum specified mean value. The test temperature shall be in accordance with Table A.13 of this specification (MSW-01-E).

Substitution **A.4.4.2 Pipe weld and heat affected zone**

The minimum average (set of three test pieces) absorbed energy for pipe weld and heat affected zone, based upon full-size test pieces, shall be 40 J. Single values of the absorbed energy shall be at minimum 30 J. The test temperature shall be in accordance with Table A.13 of this specification (MSW-01-E).

**A.5 TOLERANCES FOR DIAMETER, WALL THICKNESS, LENGTH, AND STRAIGHTNESS**

Substitution **A.5.2**

The wall thickness shall be within the tolerances given in Table A.4 of this specification (MSW-01-E).

Substitution Table A.4 Tolerances for wall thickness

Wall thickness $t$ mm	Tolerances <sup>a</sup> mm
<b>SMLS pipe <sup>b</sup></b>	
$\leq 4,0$	+ 0,6 - 0,5
$> 4,0$ to $< 25,0$	+ 0,150 $t$ - 0,125 $t$
$\geq 25,0$	+ 3,7 or + 0,1 $t$ , whichever is the greater - 3,0 or - 0,1 $t$ , whichever is the greater
<b>Welded pipe <sup>c,d</sup></b>	
$\leq 10,0$	+ 0,45 - 0,35
$> 10,0$	upper limit is given by the admissible mass tolerances in sub clause 9.14.1 <sup>c</sup> . - 0,50
<sup>a</sup> If the purchase order specifies a minus tolerance for wall thickness smaller than the applicable value given in this table, the plus tolerance for wall thickness shall be increased by an amount sufficient to maintain the applicable tolerance range. <sup>b</sup> For pipe with $D \geq 355,6$ mm and $t \geq 25,0$ mm, the wall-thickness tolerance locally may exceed the plus tolerance for wall thickness by an additional 0,05 $t$ , provided that the plus tolerance for mass (see 9.14 of <a href="#">API SPEC 5L</a> ) is not exceeded. <sup>c</sup> The plus tolerance for wall thickness does not apply to the weld area. <sup>d</sup> See 9.13.2 of <a href="#">API SPEC 5L</a> and this specification (MSW-01-E) for additional restrictions.	

**A.6 TOLERANCES FOR THE WELD SEAM**

Substitution **A.6.1 Radial offset of coil edges**

For SAW pipe, the inside and outside radial offsets of the coil edges [see Figure 4b) or Figure 4c) of [API SPEC 5L](#)] shall not exceed the applicable value given in Table A.5 of this specification (MSW-01-E).

Substitution Table A.5 Maximum permissible radial offset for SAW pipe

Specified wall thickness $T$ mm	Maximum permissible radial offset <sup>a</sup> mm
$\leq 10,0$	1,0
$> 10,0$ to 15,0	0,1 $t$
$> 15,0$	1,5

<sup>a</sup> These limits apply also to coil end welds.

## **A.7 INSPECTION**

### *A.7.1 Inspection certificate*

#### *A.7.1.1*

Substitution the second paragraph with:

Pipes shall be certified in accordance with [MSA-32-E](#). The required inspection certificate shall be in accordance with MSA-32-E route 9 or 10, depending on the nominal diameter of the pipe.

Addition The inspection documentation shall include a list of pipe numbers, the inspection certificate of the incoming material and in case tests are performed by an external laboratory, the original test reports.

Substitution *A.7.2 Specific inspection*  
The frequency of inspection shall be as given in Table A.7 of this specification (MSW-01-E).

Substitution Table A.7 Survey of inspection (**references in bold refer to modifications of and supplements to NEN-EN-ISO 3183** and "(API)" means "(see API SPEC 5L)"))

No	Type of inspection	Type of pipe				Frequency of inspection			Sampling and test pieces see	Test method see	Requirements see
		HFI	SAWH	SAWL	SMLS	each pipe	50 <sup>d</sup>	100 <sup>d</sup>			
1	Heat analysis	X	X	X	X	One analysis per heat of steel			left to the discretion of the manufacturer	left to the discretion of the manufacturer	Table A.1
2	Product analysis	X	X	X	X	Two analyses per heat of steel			<b>10.2.2</b>	10.2.4.1 (API)	Table A.1 <b>A.4.1.3</b>
3	Tensile testing of the pipe body	X	X	X	X		$D \geq 508$ mm a,b	$D < 508$ mm a,b	10.2.3.2 (API), A.7.3.1, A.7.3.2	A.7.4.1	<b>Table A.2</b>
4	Tensile testing of the longitudinal or helical seam weld	X	X	X			$D \geq 508$ mm a,b	$D < 508$ mm a,b	10.2.3.2 (API), A.7.3.1, A.7.3.2	A.7.4.1	<b>Table A.2</b> <b>Table A.2a</b>
5	Tensile testing (all weld) of the helical seam weld		X				$D \geq 508$ mm a,b	$D < 508$ mm a,b	10.2.3.2 (API) <b>A.7.3.1</b>	<b>A.7.4.1</b>	<b>Table A.2a</b>
6	Tensile testing (all weld and transverse) of the coil end weld		X			Once per 20 coil end welds from pipe with the same cold-expansion percentage a,b,c			10.2.3.2 (API)	A.7.4.1 <b>A.7.4.1</b>	<b>Table A.2a</b>
7	CVN impact testing of the pipe body of pipe with $t$ as given in Table 22 (API)	X	X	X	X		$D \geq 508$ mm a,b	$D < 508$ mm a,b	10.2.3.3 (API) A.7.3.1, A.7.3.3	<b>A.7.4.2</b>	<b>A.4.4.1</b>
8	CVN impact testing of the longitudinal or helical seam weld with $t$ as given in Table 22 (API)	X	X	X			$D \geq 508$ mm a,b	$D < 508$ mm a,b	10.2.3.3 (API) A.7.3.1, A.7.3.3 <b>A.7.3.3</b>	<b>A.7.4.2</b>	<b>A.4.4.2</b>
9	CVN impact testing of the coil end weld with $D \geq 114,3$ mm and $t$ as given in Table 22 (API)		X			Once per 20 coil end welds from pipe with the same cold-expansion percentage a,b,c			10.2.3.3 (API) A.7.3.1, A.7.3.3	<b>A.7.4.2</b>	<b>A.4.4.2</b>
10	DWT testing of the pipe body ( $D \geq 508$ mm and $t > 8$ mm, $R_{t0.5} > 360$ MPa)	X	X	X	X		X a		10.2.3.4 (API) A.7.3.1	10.2.4.4 (API) <b>10.2.4.4</b>	9.9 (API) <b>9.9.1</b>
11	Guided-bend testing of the longitudinal or helical seam weld		X	X		Once per test unit of not more than 50 lengths of pipe with the same cold-expansion ratio <sup>a</sup>			A.7.3.1, A.7.3.4	A.7.4.4	9.7 (API) <b>9.7.3</b>
12	Guided-bend testing of the coil end weld		X			At least once per 20 coil end welds from pipe with the same cold-expansion ratio <sup>a,b,c</sup>			A.7.3.1, A.7.3.4	A.7.4.4	9.7 (API) <b>9.7.3</b>

No	Type of inspection	Type of pipe				Frequency of inspection			Sampling and test pieces see	Test method see	Requirements see
		HFI	SAWH	SAWL	SMLS	each pipe	50 <sup>d</sup>	100 <sup>d</sup>			
13	Flattening test	X				As shown in Figure 6			10.2.3.7 (API) A.7.3.1	10.2.4.7 (API)	A.7.4.5
14	Hardness testing of hard spots in cold-formed welded pipe	X	X	X		Any hard spot exceeding 50 mm in any direction			-	10.2.4.8 (API)	9.10.6 (API)
15	Hydrostatic testing	X	X	X	X	X			-	10.2.6 (API) A.7.4.3	A.4.3
16	Macrographic testing of the longitudinal or helical seam weld		X	X		At least once per operating shift plus whenever any change of pipe size occurs during the operating shift; or, if 10.2.5.3 (API) or 10.2.5.4 (API) applies, at the beginning of the production of each combination of specified outside diameter and specified wall thickness			left to the discretion of the manufacturer	10.2.5 (API)	10.2.5 (API)
17	Macrographic testing of the coil end seam weld		X			Once per 20 coil end welds from pipe with the same cold-expansion percentage a, b, c			left to the discretion of the manufacturer	10.2.5 (API)	10.2.5 (API)
18	Metallographic testing of the longitudinal seam weld	X				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			left to the discretion of the manufacturer	10.2.5 (API)	10.2.5 (API) 9.13 (API)
19	Hardness testing of pipe body and of the longitudinal seam weld	X				Same frequency as macro- or metallographic examination			left to the discretion of the manufacturer	10.2.4.8 (API)	<b>10.2.5.3</b>
20	Visual inspection	X	X	X	X	X			-	10.2.7 (API)	9.10 (API), <b>9.10.1.2</b> 9.10.5.1 (API), <b>9.10.5.1</b> <b>9.10.5.2</b> 9.10.5.3 (API), <b>9.10.5.3</b> <b>9.10.7</b>
21	Pipe diameter and out-of-roundness	X	X	X	X	X			-	10.2.8.1 (API) 10.2.8.2 (API) 10.2.8.3 (API)	9.11.1.2 (API) A.5.1
22	Wall thickness measurement	X	X	X	X	X			-	10.2.8.5 (API)	<b>A.5.2</b>
23	Other dimensional testing excluding weld seam	X	X	X	X	Random testing, with the details left to the discretion of the manufacturer			-	10.2.8.4 (API) 10.2.8.7 (API)	A.5.3 9.12 (API), <b>9.12.5.2</b>



**A.7.3 Samples and test pieces for mechanical and technological tests****A.7.3.1 General**

Addition Table A.8 Number, orientation, and location of test pieces per sample for mechanical tests

Type of pipe	Sample location	Type of test	Number, orientation and location of test pieces per sample <sup>a</sup>		
			Specified outside diameter		
			<i>D</i> mm		
			< 219,1	≥ 219,1 to < 508	≥ 508
SAWH [see Figure 5 c, API SPEC 5L]	Seam weld	Tensile	—	1W and 1AWT	1W and 1AWT
	Coil/plate end weld	Tensile	—	1WS and 1AWT	1WS and 1AWT
<sup>a</sup> See Figure 5 (API SPEC 5L) for an explanation of the symbols used to designate orientation and location. AWT all weld tensile					

Addition **A.7.3.3 CVN impact test pieces**

The CVN impact test pieces of the HFI bond line shall be in accordance with the EPRG Guidelines, Procedure for Charpy testing of the bond line of HFW pipe, 2020<sup>3</sup>.

**A.7.4 Test methods****A.7.4.1 Tensile test**

Addition The tensile strength  $R_m$ , the yield strength for 0,5 % total elongation  $R_{t0,5}$  and the percentage elongation after fracture  $A_f$  shall be determined on the helical seam and coil/plate end weld.

**A.7.4.2 CVN impact test**

Addition The CVN impact test temperature shall be in accordance with Table A.13 of this specification (MSW-01-E).

Addition Table A.13 CVN impact test temperature

specified wall thickness <i>t</i> mm	CVN impact test temperature °C
< 14	0
≥ 14 to < 19	-10
≥ 19 to < 23	-20
≥ 23 to < 25	-30
≥ 25 to < 27,5	-40
≥ 27,5 to < 30	-50

**A.7.5 Non-destructive testing**

Substitution **A.7.5.1 General**

The non-destructive test requirements and acceptance levels are defined in Table A.10 of this specification (MSW-01-E).

Substitution Table A.10 Survey of non-destructive tests<sup>4</sup>

1	2	3	4
No	NDT operation	Types of test and requirements, acceptance level	Reference
HFI, SAW pipes			
1	Residual magnetism at the pipe ends	Hall effect gauss meter or equivalent; 30 Gs max., random testing	E.7
2	Laminar imperfections at the pipe ends	Ultrasonic test EN-ISO 10893-8, acceptance limit: 6 mm max. circumferentially	E.3.2.3 E.3.3.2
SMLS pipe			
3	Longitudinal imperfections (including the pipe ends, where applicable, see A.7.5.4)	or Ultrasonic test EN-ISO 10893-10, acceptance level U2 (by agreement for $t < 10$ mm) Flux leakage test EN-ISO 10893-3, acceptance level F2	K.3.1 K.3.4.2
HFI pipe			
4	Longitudinal imperfections in the weld (including the pipe ends, where applicable, see A.7.5.4)	or Ultrasonic test EN-ISO 10893-10 or EN-ISO 10893-11, acceptance level U2 (by agreement for $t < 10$ mm) Flux leakage test EN-ISO 10893-3, acceptance level F2 or (by agreement for $D < 273,1$ mm; $t < 6,3$ mm; $D/t < 0,18$ ) Eddy current test EN-ISO 10893-2, acceptance level E2/E2H	K.4.1 K.3.4.2 (also for HFI) K.3.4.3 (also for HFI)
5	Laminar imperfections in the pipe body	Ultrasonic test EN-ISO 10893-9, acceptance level U2 or ISO EN-ISO 10893-8, acceptance level U2	E.8.1
6	Laminar imperfections on coil edges/area adjacent to weld seam	Ultrasonic test EN-ISO 10893-9 or EN-ISO 10893-8, acceptance level U2	E.9
SAW pipe			
7	Longitudinal / transverse imperfections in the weld	Ultrasonic test EN-ISO 10893-11, acceptance level U2/U2H or "two lambda" calibration method (also for the coil end weld SAWH pipe) Radiographic inspection EN-ISO 10893-6 or EN-ISO 10893-7, image quality class B, acceptance limits as per A.7.5.6, only for T-joints of SAWH pipe	K.5.1 <sup>a</sup> A.7.5.6
8	Laminar imperfections in the pipe body	Ultrasonic test EN-ISO 10893-9, acceptance level U2	E.8.2
9	Laminar imperfections on coil edges/area adjacent to weld seam	Ultrasonic test EN-ISO 10893-9 or EN-ISO 10893-8, acceptance level U2	E.9
10	NDT of the weld seam at pipe ends (untested ends) / repaired areas	or Ultrasonic test EN-ISO 10893-11 to requirements of K.5.1.1 <sup>b</sup> on longitudinal imperfections, acceptance level U2/U2H (unless otherwise agreed) Radiographic inspection EN-ISO 10893-6 or EN-ISO 10893-7, image quality class B on longitudinal imperfections and Ultrasonic test EN-ISO 10893-11 or radiographic test EN-ISO 10893-6 or EN-ISO 10893-7 on transverse imperfections, acceptance limits as per K.5.3 <sup>a</sup>	K.5.1.1 <sup>a</sup> A.7.5.6 K.5.3b <sup>a</sup>
<sup>a</sup> In these clauses the reference to clause E.4 (radiographic inspection of the weld seam) shall be replaced by clause A.7.5.6 for this annex only.			

Substitution A.7.5.3 Timing of NDT operations

NDT of all pipe shall be carried out after hydrostatic testing.

## 5. DOCUMENTATION

In this specification the following documentation is applicable:

- 1 N.V. Nederlandse Gasunie, memorandum [VA 20.0358](#), "MSW-01-E versie 12: wijzigingen t.o.v. versie 11", d.d. 09-09-2021 (not available for external parties).