DESFA Hellenic Gaz Tranamisation System Operator S.A.	Hellenic Gas Transmission System Operator S.A. 357-359 Messogion Av., GR 152 31 Halandri Tel.: 213 088 4000 Fax: 210 674 9504 Email: desfa@desfa.gr		TECHNICAL SPECIFICATION
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# **REVISION HISTORICAL SHEET**

Rev.	Date	Description
0	05/04/2011	First Issue (as Spec 171/1)
1	20/05/2021	Second Issue validated from TPI
2	30/06/2021	Third Issue Changes due to Hydrogen Requirements and EN ISO
3	02/07/2021	Changes due to Comments by SAIPEM for Hydrogen Assessment compatibility





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# 1. SCOPE

This Technical Specification covers the requirements of steel pipes for Transmission on-shore network of High Pressure (operating pressure greater than 16 bar) sweet natural gas with sporadic conveyance of water and glycol.

This Technical Specification is according to the European Standard EN ISO 3183 and all the requirements that are set there in are fully valid.

However, this Technical Specification outlines the basic requirements and specifies some preferences with respect to the EN ISO 3183 whenever they exist there in. So for details the user refers to the relevant paragraphs of EN ISO 3183 that are mentioned here below for each individual aspect.

This Specification also contains in Annex A special requirements for the qualification of pipes suitable for the transportation of Hydrogen as a blend with Natural Gas or a stand-alone product.

# 2. REFERENCES

## 2.1. REFERENCE DOCUMENTS

- Tech Spec. No. DSF-SPC-QAC-005 [Shop Inspection of equipment and materials for NGT project]
- Tech Spec. No. DSF-SPC-QAC-006 [Inspection and Test Instructions]

## 2.2. REFERENCE CODES AND STANDARDS

- EN ISO 3138 [Petroleum and natural gas industries Steel pipe for pipeline transportation systems]
- EN ISO 148-1 [Metallic materials. Charpy pendulum impact test. Test method]
- EN 10274 [Metallic materials Drop weight tear test]
- EN ISO 10893 series [Non-destructive testing of steel tubes]
- EN 10204 [Metallic products Types of inspection documents]
- API 5L [Line Pipe]





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# 3. GENERAL REQUIREMNTS

## 3.1 SPECIFICATIONS

PSL 2 Steel Pipe NE (normalized, normalized rolled) or ME (thermomechanically rolled), as described in Annex A of EN ISO 3183: 'PSL 2 pipe ordered for European onshore natural gas transmission pipelines" EN ISO 3183.

## 3.2 UNITS

Metric system, except pipe sizes.

## 3.3 MANUFACTURING

The following types of pipes shall be acceptable for use depending on the application and OWNER requirements:

- Seamless (SMLS)
- High frequency welded (HFW)
- Submerged arc-welded longitudinal (SAWL
- Submerged arc-welded helical (SAWH) alternatively for D>24" (DN600)

Type of pipe shall always be PSL 2 and manufacturing route (starting material, pipe forming and heat treatment conditions) as per paragraph A.3 of EN ISO 3183 Only pipes with one (single) seam weld are accepted.

For each project the grade of the steel shall be defined according to the design requirements, mentioned on the purchase order sheet.

#### 3.3.1. DIMENSIONS, MASSES AND TOLERANCES

As per paragraph A.5 of EN ISO 3183 and table A.3: "Tolerances for diameter and out-of-roundness" and table A.4: "Tolerances for wall thickness". Tolerances for the weld seam as described in paragraph A.6 of EN ISO 3183 shall also be applicable.

#### 3.3.2. PIPE LENGTHS

Pipe length shall be as mentioned in the DATA SHEET. Tolerances for the pipe length shall be in accordance with Table 12 of API 5L.



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#### 3.3.3. FINISH OF PIPE ENDS

Unless otherwise agreed, pipe ends shall be beveled for welding in accordance with paragraph 9.5.12.2 of API 5L.

For pipes smaller than DN 40 no beveling is required.

## 3.4 CHEMICAL COMPOSITION

For steel pipe NE and ME as per table A.1: "Chemical composition for pipe with t  $\leq$  25 mm" EN ISO 3183.

Carbon equivalent as defined in table A.1, EN ISO 3183.

# 4. INSPECTION – TESTS

#### 4.1 INSPECTION

#### 4.1.1. TYPE OF INSPECTION

- a) Third Party Inspections shall be performed by a suitably Accredited Inspection Body unless otherwise specified by the OWNER.
- b) The type of Certification required by the manufacturer will be according to requirements stated in Tech Spec. No. DSF-SPC-QAC-005, par. 2.1 & 3.1.

Frequency of inspection shall follow the requirements of table A.7 of EN ISO 3183.

#### 4.2 TESTS

4.2.1 CHEMICAL ANALYSIS

As per table A.1, EN ISO 3138.

#### 4.2.2. TENSILE TEST

As per paragraph A.4.2 and table A.2, EN ISO 3183.

#### 4.2.3. IMPACT TESTS

Charpy V-notch impact test specimens shall be taken as described in tables A.7 and A.8 of EN 3183 for each testing unit with all specimens being removed transverse to the





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longitudinal axis and with a test temperature not higher than-20°C, unless a lower temperature is specified in the DATA SHEET.

The minimum average impact energy values shall satisfy the requirements of Table G1, API 5L. Impact tests on the HAZ and the weld metal for pipe types SAWL and SAWH shall be performed at -20 °C with the same acceptance criteria as those of the pipe base metal. All charpy specimens shall exhibit 85% ductile fracture area at the testing temperature.

#### 4.2.4. DROP WEIGHT TEAR (DWT) TEST

DWT test shall be performed when specified by the DATA SHEET. Frequency and type of testing shall be in accordance with tables A.7 and A.8 of EN 3183. DWT testing shall be performed at the minimum design temperature. For each DWT test the average shear fracture area shall be  $\geq$  85 %.

#### 4.2.5. BEND TEST

As per paragraph 7.3 and 7.4, EN ISO 3183.

#### 4.2.6. FLATTENING TEST

As per paragraph 7.3 and 7.4, EN ISO 3183.

#### 4.2.7. HYDROSTATIC TEST

The minimum permissible wall thickness shall be used for the calculation of the testing pressure. Each length of pipe shall withstand the test without leakage or visible deformation

#### 4.2.8. VISUAL EXAMINATION

All pipes shall be free from defects in the finished condition. Any surface defects shall be identified and evaluated based on the acceptance criteria of API 5L paragraph J.5

#### 4.2.9. DIMENSIONAL TESTING

Dimensional testing frequency shall be in accordance with table A.7, EN ISO 3183. Additional dimensional testing can be specified in the DATA SHEET



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4.2.10. WEIGHT

As per paragraph 10.2.9 API 5L

#### 4.2.11. NON DESTRUCTIVE TESTING

As per paragraph A.7 and table A.10, EN ISO 3183 . The following preferences are valid:

#### "Timing of NDT operations"

NDT of the weld seam of HFW pipe less than 200 mm outside diameter and full body NDT of seamless pipe shall be carried out before or after the hydrostatic test. NDT of the weld seam of SAW pipe and HWF pipe equal to or greater than 200 mm outside diameter, shall be carried out after the hydrostatic test.

#### "Residual magnetism at the ends"

The residual magnetism at the ends of the ends of each pipe, in the direction parallel to the pipe axis shall not exceed 30 G (3mT). Measurement for checking compliance with requirement shall be as per table A.10, EN ISO 3183.

"Laminar imperfections at the pipes ends"

Laminar imperfections greater than 6 mm in the circumferential direction are not permitted within 25 mm of each end of the pipe.

Verification of this requirement shall be carried out with an ultrasonic test as per EN ISO 10893-8.

Laminar and longitudinal imperfections at the pipe ends are tested according to table A.10, EN ISO 3183 for welded and seamless pipes.

The pipe body shall be 100% tested for longitudinal and laminar imperfections in accordance with table A.10 for welded and seamless pipes.

#### "Untested pipe ends"

In the case of short length at both pipe ends that cannot be tested the following apply: for seamless or HFW pipe, the untested ends shall be subjected to a manual/semi-automatic test using the same technique, test sensitivity, test parameters etc as specified in the



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relevant clauses of EN ISO 3183. For manual testing, the scanning speed shall not exceed 150 mm/s.

#### "Suspect pipe"

In all cases, pipes giving rise to indications producing a trigger/alarm condition as a result of the specified NDT operation(s) shall be deemed suspect.

Suspect pipe shall be dealt with in accordance with the clause 'Acceptance' as given in the relevant European Standard for NDT of pipe. Repair by welding is only permitted on the weld of non-cold-expanded SAW pipe, provided that the provisions of paragraph C4 of API 5L are fulfilled. All repair welding procedures shall be qualified and approved by the Owner.

"Radiographic inspection of the weld seam"

Where applicable, radiographic inspection of the weld seam shall be conducted in accordance with EN ISO 10893-6 to image quality class B, with the conditions and the acceptance criteria given in paragraph A.7.5.6, EN ISO 3183.

# 5. PIPES QUALIFIED FOR TRANSOPORTATION OF HYDROGEN

When required by the DATA SHEET the pipes shall be qualified for the transportation of Hydrogen in accordance with the requirements included in Annex A of this specification.

# 6. PIPE MARKING

As per clause 4.4 EN ISO 3183.

Additionally, the OWNER CONTRACT identification number shall be paint stenciled.

#### **6.1 ADDITIONAL MARKING REQUIREMENTS**

6.1.1 REFLECTIVE PAINT FOR PIPE D  $\geq$  355.6 MM In addition to the above the following shall be marked in white reflective weather resistant paint on pipe D  $\geq$  355.6 mm only:

- Welding seams at each end of pipe.
- Die stamping to be framed.



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• Length of pipe (in meters to two decimals) to be marked internally on one end of pipe. This requirement may be omitted on coated pipe if the information is "colour" stamped onto the external coating.

• Circumferential band midpoint of pipe if specified on DATA SHEET.

# 6.2 COLOR CODING

If required on the DATA SHEET, pipes of the same diameter, but with different wall thickness, are to be color codes at each end of the pipe, by two painted circumferential bands or similar, in order of increasing wall thickness, as follows:

No color / yellow / red / blue.

As an alternative to painting a corresponding coloring of the coating marking (if any) may be used.

# 7 TECHNICAL DOCUMENTATION

# 7.1 QUANTITY

Four copies of each inclusive of original for all Documents and Certificates.

Also, electronic files of all Documents and Certificates must be submitted by Contractor to the Owner.

## 7.2 DOCUMENTS REQUIREMENTS

#### 7.2.1 WITH TENDER

Information about type(s) of surface treatment offered.

Statement of the test pressure applied in the hydrostatic test (standard, alternative or special pressure).

Statement of the Non Destructive Examination applied inclusive of test method in use, scanning pattern, notch standard etc.

## 7.2.2 AFTER AWARD OF CONTRACT

Manufacturers Detailed Test and Inspection plan approved by OWNER. The plan shall additionally show the control points at which the independent inspectors witnessing /





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approval is required as per section 4.1 herein. (This clause is not applicable to "Stock list" supplied pipe).

# 7.2.3 ON DELIVERY

Pipe Certification Package as per EN ISO 3183.

OWNER or Third Party Accredited Inspection Body will issue Inspection Release Note (IRN) if not completed / included in Pipe Certification Package.





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#### ANNEX A

# PIPE QUALIFICATION REQUIREMENTS FOR THE TRANSPORTATION OF HYDROGEN

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# Hydrogen Pipelines ASME B31.12 Requirements for Option B Qualification

The following Table presents an outline of the requirements of ASME B31.12-2019 for the Qualification of high grade API 5L / EN ISO 3183 Pipelines for the transportation of Hydrogen or Natural Gas - Hydrogen mixtures at increasing percentages.

<u>Reference standard</u>: ASME B31.12-2019, section "PART PL Pipelines".

SN	Reference	lssue	Requirement Description	Application Status	Remarks
1.	ASME PL-3.7.1	Qualification procedure for Option B (performance- based design method for design factor up to 0,72)	<ul> <li>The pipe and weld material shall be qualified for adequate resistance to fracture in hydrogen gas at or above the design pressure and at ambient temperature, using the applicable rules provided in Article KD-10 of ASME BPVC, Section VIII, Division 3.</li> <li>To qualify the construction material, three heats of the material shall be tested.</li> <li>Testing should include a set of three specimens from each of the following locations: Base metal, weld metal and HAZ (for SAW).</li> <li>The values of K<sub>IH</sub> shall be obtained by use of the test method described in KD-1040.</li> <li>The measured K<sub>IH</sub> value shall not be less than the value of 55 MPa*m<sup>0,5</sup>.</li> </ul>	Mandatory	

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CNI	Poforonco	lecuo	Poquiroment Description	Application	Bomarks
JIN	Reference	issue	Requirement Description	Status	Remarks
2.		Range of K <sub>IH</sub> qualification	The K <sub>IH</sub> qualification results can be used for subsequent productions from the same material specification/grade and chemical composition as defined in Table PL-3.7.1-4, provided that its tensile and yield strengths do not exceed the values of the material used in the qualification by more than 5% and that the requirements of the WPS used in the original qualification are		New K <sub>IH</sub> qualification testing to be performed in case of different steel supplier. <u>Exception</u> : Coils/plates from the same steel supplier but different mills can be qualified on
			met.		test campaign, provided they follow similar steelmaking practices.
3.	ASME PL-3.7.1	Fracture control and arrest	Pipeline Material shall be CVN tested according to Annex G API 5L at a temperature not higher than the design minimum temperature. Minimum average CVN shall be calculated as $CVN = 0,008(RT)^{0,39}\sigma_h^2$ Where R=radius of pipe, in. T=nominal wall thickness, in.	Mandatory	Applicable to DN ≥ 114.3mm

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SN	Reference	Issue	Requirement Description	Application	Remarks
				Status	Nemarks
			$\sigma_h$ =nominal design hoop stress (typically 0,72).		
4		Tensile strength	Average shear area shall be ≥85%. Maximum UTS shall not exceed 100ksi (689MPa) for Option A or	Mandatory	
4.	ASME PL-3.7.1		110ksi (758MPa) for Option B.	,	
5.		Chemical analysis (for	Phosphorous content of pipe material shall not exceed 0,015% wt. Sulfur content shall not exceed 0.010%	Mandatory	
		option B)	The pipe material shall be manufactured with inclusion shape- controlled practices.		
6.	ASME Non- mandatory Appendix G	Microstructure	The desired steel microstructure is one of polygonal ferrite and acicular ferrite as uniformly distributed through the steel cross section.	Optional / Recommended	
7.		Chemical analysis	<ul> <li>Carbon shall not exceed 0,07%.</li> </ul>	Optional / Recommended	In case of P <sub>cm</sub> value range exceeds the Appendix G
			<ul> <li>Carbon equivalent Pcm as below:</li> <li>API 5L X52-X60: 0,15% maximum.</li> <li>API 5L X65-X80: 0,17% maximum.</li> </ul>		recommended limits, one of the three heats for $K_{IH}$ testing to be selected with the highest $P_{cm}$ .
8.		Segregation control	A slab macro etch or other equivalent method shall be used to identify alloy centerline segregation during the continuous casting process. Use of sulfur prints is not an equivalent method.	Optional/ Recommended	Segregation control practice is mandatory in case of P <sub>cm</sub> values

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SN	Reference	Issue	Requirement Description	Application Status	Remarks
			The slab macro etch test must be carried out on the first or		exceeding the Appendix
			second slab of each casting sequence and graded with an		G recommended limits.
			acceptance criterion of two maximum on the Mannesmann scale		
			of 1 to 5 or equivalent.		
9.		Steel making	The steel shall be niobium micro alloyed.		
			Thermomechanical control processing (TMCP) shall be used in	Mandatory	
			steel making.		
10.		Grain size	ASTM 9 or finer.	Mandatory	
11.		Hardness	Hardness shall be limited to 235 HV10 in accordance with Table	Mandatory	
			GR 3.10 of API 5L.		