



Offshore Design Section
Engineering Services
ISO – 9001:2008

Functional Specification
for
Carbon Steel Seamless
Line Pipe for Submarine
Pipelines

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**SPECIFICATION
FOR
CARBON STEEL SEAMLESS LINE PIPE
FOR
SUBMARINE PIPELINES**

**OIL AND NATURAL GAS CORPORATION LTD.
INDIA**

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33	19.07.2016	5	
TOTAL NO. OF PAGES	DATE	REV.NO.	



SCOPE

This specification establishes the minimum requirements for the materials, fabrication, inspection, testing and supply of seamless carbon steel line pipe to be used for submarine pipelines and risers transporting non-sour applications. Line pipes furnished in accordance with this specification shall meet the requirements of **API Specification 5L, Forty-Fifth Edition and the supplementary requirements stated herein.**

All carbon steel pipes made according to this specification shall be PSL2.

This specification covers seamless line pipes of pipe diameters up to 406.4 mm OD (16 inches) and grades up to Grade L450 (X65). The Manufacturer shall have the license to use API monogram for manufacturing of pipes in accordance with the requirements of API Spec 5L, **Forty-Fifth Edition.**

“COMPANY” means “Oil and Natural Gas Corporation Ltd.”, wherever used in this specification.

NOTE

The sections, paragraphs contained herein have the same numbering as the sections and paragraphs of API 5L, in order to facilitate reference.

In this Specification, amendments to API 5L fall into the following Categories:

- | | |
|-------------------|--|
| ADD | Where additions have been made to the API 5L clause or paragraph. |
| AMEND | Where the API 5L clause has been modified. Only the modified portions will be detailed in this Specification |
| DELETE | Where the complete clause or paragraph is to be disregarded. |
| SUBSTITUTE | Where the text has been substituted for the complete clause or paragraph in API 5L. |



6 PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 Pipe Grade and Steel Grade

6.1.2 ADD

Maximum pipe grade shall be up to Grade L450 (X65), where 450 represents the Yield Strength in MPa.

6.2 Delivery Condition

6.2.2 ADD

The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.

7 INFORMATION TO BE SUPPLIED BY THE PURCHASER

7.1 General Information

The purchase order shall include the following information:

SUBSTITUTE

Sl. no	Information to be provided as per API 5L	Information provided by the COMPANY to be incorporated in PO/PS.
a)	quantity(e.g. total mass or total length of pipe)	As per provisions of the Contract.
b)	PSL (1 or 2)	PSL2
c)	type of pipe (see Table 2)	Seamless
d)	reference to API 5L	API Spec 5L, Forty-Fifth Edition
e)	steel grade (see 6.1, H.4.1.1 or J.4.1.1, whichever is applicable)	J.4.1.1 of API 5L shall be applicable.
f)	outside diameter and wall thickness (see 9.11.1.2)	As per provisions of the Purchase Specification
g)	length and type of length random or approximate) (see 9.11.1.3, 9.11.3.3 and Table 12)	Refer J.6.3 of API 5L of Forty-Fifth Edition
h)	confirmation of applicability of individual annexes.	The applicable Annexes as shown in the following supplementary Table:



Applicable Annexures:

Annex.	Service
Annex B (Amended) -Manufacturing procedure qualification for PSL 2 pipe	Offshore Service
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore Service
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore Service
Annex K (Amended) - Non-destructive inspection for pipe ordered offshore service	Offshore Service

Note: In case of any contradiction between different clauses of this Specification, the most stringent clause shall prevail upon.

7.2 ADDITIONAL INFORMATION

SUBSTITUTE

a)	Items that are subject to mandatory agreement, if applicable:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	pipe designation for intermediate grades [see Table 1, footnote a)]	Not applicable
2	chemical composition for intermediate grades (see 9.2.1 and 9.2.2)	Not applicable
3	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see 9.2.3)	J.4.1.1 of API 5L shall be applicable.
4	carbon equivalent limits for PSL 2 pipe in Grade L415N or X60N (see Table 5)	Refer 9.2.4 & 9.2.5 of this specification.
5	carbon equivalent limits for PSL 2 pipe in Grade L555Q or X80Q, L625Q or X90Q, and L690Q or X100Q (see Table 5),	Not applicable
6	carbon equivalent limits for PSL 2 SMLS pipe with $t > 20,0$ mm (0.787 in) [see Table 5, footnote a)],	Refer 9.2.4 & 9.2.5 of this specification.



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7	diameter and out-of-roundness tolerances for pipe with $D > 1422$ mm (56.000 in) (see Table 10)	Not applicable
8	diameter and out-of-roundness tolerances for the ends of SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table 10, footnote b)]	Table 10 of API 5L 45 th Edition is not applicable. Refer J.6.1 of API 5L 45 th Edition.
9	standard applicable to jointer welds (see A.1.2)	Not applicable. Jointers are not permitted.

b)	Items that apply as prescribed, unless otherwise agreed:	
Sl. no.	Information to be provided as per API 5L	Information by the COMPANY to be incorporated in PO/PS.
1	range of sizing ratio for cold-expanded pipe (see 8.9.2)	Not applicable.
2	equation for sizing ratio (see 8.9.3)	Not applicable.
3	chemical composition limits for PSL 1 pipe [see Table 4, footnotes c), e) and f)]	Not applicable.
4	chemical composition limits for PSL 2 pipe [see Table 5, footnotes c), e), f), g), h), i), k), and l)],	Footnote g) of Table J.1 of API 5L is not applicable.
5	yield/tensile ratio for grades L625Q or X90Q, L690 or X100 and L830 or X120 [see Table 7, footnotes g and h or Table J.2, footnotes h and i],	Not applicable
6	estimation and reporting of Charpy shear area (see 9.8.2.3)	Not applicable
7	tolerances for random length pipe [see 9.11.3.3 a)]	Refer J.6.3 of API 5L 45 Th Edition
8	type of thread compound (see 9.12.2.4)	Not applicable
9	type of end face (see 9.12.5.1 or 9.12.5.2)	Section 9.12.5.2 of API 5L shall be applicable.
10	International Standard applicable to Charpy testing (see 10.2.3.3, 10.2.4.3, D.2.3.4.2 and D.2.3.4.3)	Charpy V- notch testing shall be done in accordance with ASTM A370.
11	product analysis method (see	As per Section 10.2.4.1 of API



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	10.2.4.1),	5L
12	alternate method for diameter measurement for $D \geq 508$ mm (20.000 in) (see 10.2.8.1),	Not Applicable
13	jointer welding type (see A.1.1),	Not applicable
14	offset of longitudinal pipe weld seams at jointer welds (see A.2.4)	Not applicable
15	repairs in cold-expanded pipe (see C.4.2)	Not applicable.
16	alternate IQI type (see E.4.3.1);	Not applicable.

c)	Items that apply, if agreed:	
Sl. no.	Information to be provided as per API 5L	Information by ONGC to be incorporated in PO/PS.
1	delivery condition (see 6.2 and Table 1)	PSL 1 shall not be applicable. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.
2	supply of quenched and tempered PSL 1 Grade L245 or B SMLS pipe (see Table 1),	Not applicable.
3	supply of intermediate grades [see Table 2, footnote a)]	Not applicable.
4	supply of double-seam SAWL pipe [see Table 2, footnote c)]	Not applicable.
5	alternative to specified seam heat treatment for PSL 1 pipe (see 8.8.1)	Not applicable.
6	supply of SAWH pipe with coil/plate end welds at the pipe ends (see 8.10.3),	Not applicable.
7	supply of jointers (see 8.11)	Not applicable .Jointers are not permitted
8	CVN impact test temperature lower than 0°C (32°F) (see 9.8.2.1, 9.8.2.2 and 9.8.3)	CVN impact test temperature lower than 0°C (32°F) is not applicable.
9	CVN impact test of the pipe body of PSL 2 welded pipe with $D < 508$ mm (20.000 in) for shear fracture area (see 9.8.2.2 and Table 18)	Not applicable.
10	CVN impact test of the longitudinal seam weld of PSL 2 HFW pipe (see 9.8.3 and Table 18)	Not applicable.



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11	DWT test of the pipe body of PSL 2 welded pipe with $D \geq 508$ mm (20.000 in) (see 9.9.1 and Table 18)	Not applicable.
12	DWT test temperature lower than 0°C (32°F) (see 9.9.1)	Not applicable.
13	fraction jointers comprising 2 or 3 pieces for 12 m (40 ft) nominal or 24 m (80 ft) nominal, respectively [see 9.11.3.3.c), d), and e)],	Not applicable.
14	power-tight make-up of couplings (see 9.12.2.3 and 10.2.6.1)	Not applicable.
15	special bevel configuration (see 9.12.5.3)	Not applicable.
16	removal of outside weld bead at pipe ends of SAW or COW pipe [see 9.13.2.2 e)]	Not applicable.
17	weldability data or tests for PSL 2 pipe (see 9.15)	For X65 Grade Pipe only (As per 9.15 of this specification)
18	type of inspection document for PSL 1 pipe (see 10.1.2.1)	Not applicable.
19	manufacturing information for PSL 1 pipe (see 10.1.2.2)	Not applicable.
20	alternative type of inspection document for PSL 2 pipe (see 10.1.3.1)	Refer 10.1.3.1 (Amended) of this Specification.
21	use of transverse test pieces for tensile tests of SMLS pipe, not cold-expanded [see Table 20, footnote c)]	<ul style="list-style-type: none"> For pipe OD > 219.1mm both transverse and longitudinal tensile test shall be carried out. Testing frequency shall be as per this specification. For pipe OD ≤ 219.1mm the test shall be carried out in longitudinal direction only; however longitudinal tensile testing frequency shall be as per this specification.
22	use of the ring expansion test for transverse yield strength determinations [see 10.2.3.2, Table 19 note c), and Table 20 note d)],	Not Applicable.
23	use of an alternative to macrographic examination (see 10.2.5.2)	Not applicable
24	hardness test during production of EW and LW pipe (see 10.2.5.3)	Not applicable



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25	specific condition to be used for hydrostatic tests for threaded and coupled pipe (see 10.2.6.1)	Not applicable
26	alternate hydro test pressure (see Table 26),	Table 26 of API 5L 45 th Edition is not Applicable. Refer 10.2.6 (Substituted) of this specification.
27	use of minimum permissible wall thickness to determine hydrostatic test pressure (see 10.2.6.7)	Applicable.
28	specific method to be used for determining pipe diameter (see 10.2.8.1)	Clause 10.2.8.1 is Applicable. Further, Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 of API 5L.
29	use of inside diameter measurements to determine diameter and out-of-roundness for expanded pipe with $D \geq 219,1$ mm (8.625 in) and for non-expanded pipe [see 10.2.8.3 and Table 10, footnote c)].	Acceptable. Refer Cl. J.6.1 and Cl.10.2.8.3 of API 5L, 45th Edition).
30	specific method to be used for determining other pipe dimensions (see 10.2.8.7)	Proposed methods shall be subject to COMPANY approval.
31	paint-stencilled markings for couplings (see 11.1.2)	Not applicable
32	additional markings specified by the purchaser (see 11.1.4)	For segregation of pipes additional markings/colour bands may be decided by the LSTK contractors.
33	specific surface or location for pipe markings [see 11.2.2 b) and 11.2.6 b)]	Applicable.
34	die-stamping or vibro-etching of pipe (see 11.2.3)	Only low stress die stamping shall be permitted on the pipe bevel face preferably at the opposite end to pipe stencilled markings. The low stress marking shall be the unique pipe number only. Cold die stamping is not permitted on the pipe body.



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		In case low stress die-stamping on bevel face is technically not feasible, alternate measures shall be made for providing unique pipe number for ensuring traceability of pipes.
35	alternative location for marking the pipe (see 11.2.4)	Marking shall be carried out at the pipe mill. Further, for pipes intended for subsequent coating, LSTK contractor shall submit the procedure for marking at coating yard ensuring the traceability of pipes.
36	alternative format for pipe length marking locations (see 11.2.6a),	Not applicable.
37	colour identification for pipe (see 11.2.7)	As per 11.2.7 of API 5L.
38	multiple grade marking (see 11.4.1),	Not applicable.
39	temporary external coating (see 12.1.2)	Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.
40	special coating (see 12.1.3)	Not applicable
41	lining (see 12.1.4),	Not applicable
42	manufacturing procedure qualification for PSL 2 pipe, in which case, Annex B shall apply (see B.2),	Refer Annex B (Amended) of this specification.
43	radiographic inspection of SAW seam or coil/plate end seam (see Table E.1)	Not applicable
44	non-destructive inspection of PSL 1 SMLS pipe (see E.3.1.2),	Not applicable
45	NDT of EW seam welds after hydrotest [see E.3.1.3 b)],	Not applicable
46	ultrasonic inspection of welded pipe for laminar imperfections at pipe ends (see E.3.2.3)	Not applicable
47	ultrasonic inspection of SMLS pipe for laminar imperfections at pipe ends (see E.3.3.2)	Refer Annex.K (Amended) of this Spec.
48	radiographic inspection in	Not applicable



	accordance with Clause E.4,	
49	use of both holes and notches in ultrasonic reference standard (see Table E.7),	Acceptable
50	alternative re-inspection technique for COW seams (see E.5.5.5)	Not applicable
51	ultrasonic inspection for laminar imperfections in the pipe body of EW, SAW or COW pipe (see Clause E.8)	Not applicable
52	ultrasonic inspection for laminar imperfections along the coil/plate edges or the weld seam of EW, SAW or COW pipe (see Clause E.9)	Not applicable
53	supply of welded couplings on pipe with $D \geq 355,6$ mm (14.000 in) (see F.1.4)	Not applicable
54	application of Annex G to PSL 2 pipe where purchaser shall specify the toughness test temperature, the minimum energy for each test and the minimum average energy value required for the order (see G.2),	Refer 9.8.2.1 (Amended) of this specification
55	PSL 2 pipe for sour service, in which case, Annex H shall apply (see H.2),	Not Applicable
56	TFL pipe, in which case, Annex I shall apply (see I.2),	Not applicable
57	pipe for offshore service, in which case, Annex J shall apply (see J.2),	Refer Annex J (Amended) of this specification
58	any other additional or more stringent requirements.	As included within this document.


8 MANUFACTURING

8.1 Process of Manufacture

ADD

This specification is applicable for seamless pipe only. Other types of pipes specified in Table 2 and pipe for intermediate grades (refer footnote a) of Table 2 are not applicable in this specification. The pipe shall be “normalized” or “normalized and tempered” or “quenched and tempered”.

8.3 Starting Material

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8.3.2 AMEND

Pipes furnished to this specification shall be made from basic-oxygen steel or electric arc furnace steel. Steel shall be vacuum degassed.

Steel shall be made by continuous casting only. Pipes shall be seamless construction. Manufacturing procedure as mentioned in Annex B (Amended) of this specification shall be prepared and submitted to Company for approval prior to start of production.

8.3.3 ADD

The steel shall be fully killed and made with fine grain structure with a grain size of ASTM 7 or finer as per ASTM E 112.

8.9 Cold Sizing and cold expansion

SUBSTITUTE

Cold expansion shall not be permitted for seamless pipes.

8.11 Jointers

AMEND

Jointers shall not be permitted.

8.12 Heat Treatment

ADD

The pipes shall be “normalized” or “normalized and tempered” or “quenched and tempered”. Other types of heat treatment shall be agreed upon between the COMPANY and Manufacturer. Temperature of furnace shall be controlled and recorded and such records shall be accessible to Company.

9 ACCEPTANCE CRITERIA

9.2 Chemical Composition

9.2.4 SUBSTITUTE

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For steels with carbon content $\leq 0.12\%$, the PCM value based on product analysis shall be limited to Table J.1 of API 5L but in no case shall exceed 0.21, when calculated using the formula given below:

$$CE_{PCM} = C + \frac{Ni}{60} + \frac{Si}{30} + \frac{Mn+Cu+Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

9.2.5 SUBSTITUTE

For steel with carbon content $> 0.12\%$, the Carbon Equivalent (CE) based on product analysis shall be limited to Table J.1 of API 5L but in no case shall exceed 0.40, when calculated using the formula given below:

$$CE_{IIW} = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

9.8 CVN Impact Test for PSL 2 Pipe

9.8.1 General

ADD

The Manufacturer shall perform the Charpy V-notch tests in accordance with the latest edition of ASTM A 370 using absorbed energy criteria and the requirements mentioned herein.

Flattening of specimens shall not be permitted. Specimens shall be taken in a transverse direction. When it is not feasible to secure even half-size specimens in transverse direction because of pipe size or wall thickness, test specimens shall be taken in a longitudinal direction to pipe axis. The energy requirements for longitudinal specimens shall be 1.5 times those of transverse specimens as detailed in 9.8.2.1(Amended) of this specification.

In addition, CTOD tests shall be carried out as per the requirement of the first day production tests. Refer Annex B (Amended).

9.8.1.3 AMEND

Tests shall be conducted at 0°C (32°F)

9.8.2 Pipe Body Tests

9.8.2.1 AMEND

The minimum average (of a set of three test pieces) and minimum individual absorbed energy for each pipe body test shall be as given in Table 8



(substituted), based upon full-size test pieces and a test temperature of 0 °C (32 °F). Test temperature lower than 0°C (32°F) is not applicable.

TABLE 8 (SUBSTITUTED)

API 5L Table-8 is substituted as under:

Grade	Min. Average	Min. Individual
X-42	29J	22J
X-46	32J	24J
X-52	36J	27J
X-56	39J	29J
X-60	41J	31J
X-65	43J	33J

Note: The average impact values are determined by finding the mean of the values of each group of three specimens from each sample taken separately. The minimum impact value is determined by considering the values of the individual specimens from the sample.

9.10 Surface Conditions, Imperfections and Defects

9.10.1 General

9.10.1.2 ADD

No cracks shall be permitted. Section of the pipe containing cracks shall be cut off as per the requirement of clause C.3(b) or entire pipe length shall be rejected as per the requirement of clause C.3.(c) of API 5L.

9.10.1.3 AMEND

The acceptance criteria for imperfections found by non-destructive inspection shall be in accordance with Annex K (amended) of this specification.

9.10.2


(c) AMEND

Undercuts that exceed the limits specified in item b) shall be classified as defects and shall be treated in accordance with API 5L para C.3 (b) or (c).

9.10.4 Laminations

ADD

Refer Annex K (Amended).

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9.10.5 Geometric Deviations

9.10.5.2 AMEND

Depth of dent shall not exceed 2 mm and length in any direction shall not exceed half of the pipe diameter, provided this dent does not give rise to a hard spot at the internal surface exceeding 250 HV10. Disposition of dents shall be carried out in accordance with API 5L para C.3.b) or C.3.c) of Annex C.

9.10.6 Hard Spots

SUBSTITUTE

Any hard spot larger than 50 mm (2.0 in) in any direction shall be classified as a defect if its hardness exceeds 250 HV10 based upon individual indentations. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C(Amended).

9.10.7 Other Surface Imperfections

SUBSTITUTE

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

- (a) Imperfections that have a depth $\leq 0.05t$ 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.
- (b) Imperfections that have a depth $> 0.05t$ 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 (Amended) or shall be treated in accordance with Clause C.3.
- (c) Imperfections that encroach on the minimum permissible wall thickness shall be classified as defects and shall be treated in accordance with Clause C.3.


9.11 Dimensions, Mass and Tolerances

9.11.3 Tolerances for Diameter, Wall Thickness, Length and Straightness

AMEND

Tables 10, 11 & 12 of API 5L shall not be applicable.

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9.11.3.1 SUBSTITUTE

Tolerances for diameter and out-of-roundness shall be as per Tabl3 J.3 of API Specification 5L.

9.11.3.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table 11 shall not be applicable.

9.11.3.3 Refer J.6.3 of API 5L

9.11.3.4 SUBSTITUTE

The tolerances for straightness shall be as per J.6.4 of API Specification 5L

9.15 Weldability Test for PSL2 Pipe


Amend

FOR GRADE X-65 ONLY Manufacturer shall carry out a weldability test to establish that quality girth welding meeting various requirements mentioned in this specification can be achieved under simulated site conditions. This test shall be carried out using pipes from any of the first three heats with highest carbon equivalent for each wall thickness and each grade of steel specified in the purchase order. In case more than one mill is proposed to manufacture pipes, the weldability test shall be carried out for each mill.

Welding procedure shall comply with the requirements of DNV-OS-F101. Procedure for field weldability test shall be submitted by the manufacturer in line with DNV-OS-F101and approved by purchaser prior to commencement of test.

Weldability test shall include all tests listed in DNV-OS-F101 aimed at establishing the weld quality/ properties as per this specification. The acceptance criteria shall be as per the requirements of this specification. In case of failure of any test results to comply the specification requirements, manufacturer shall revise the welding procedure adopted and carry out the tests again to comply the specification requirements. Manufacturer shall submit the test results to purchaser to comply specification requirements prior to shipment of pipes.

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10 INSPECTION

10.1.3. Inspection documents for PSL 2 pipe

10.1.3.1 AMEND


Inspection certificate shall be issued and validated as per “3.1C” in accordance with ISO 10474 : 1991.

10.1.3.2 SUBSTITUTE

The manufacturer shall provide production report including acceptance test certificates as mentioned in 13 of API Specification 5L (as applicable for seamless pipe) in six copies, which shall include the results of all testing required as per this specification and performed on raw material and delivered pipes giving details of, but not limited to the following for each pipe length:

- COMPANY's Name and Order Number;
- SUPPLIER's Identification;
- Name and location of facilities used for pipe manufacturing and steelmaking
- Pipe specified outside diameter, specified wall thickness, pipe grade
- Product Specification Level (PSL) and delivery condition;
- Steelmaking Process;
- Identification of Steel Type and Grade;
- Billet number, as applicable;
- Certificates of Product and Ladle Analysis;
- CE_{IIW} & Pcm for both Product and Ladle Analysis;
- Pipe Identification number, Heat number, Pipe length and Pipe weight
- Certified measurements for Dimensional measurements/ tolerance
- Mechanical Test Certificates, including hardness surveys;
- Yield/Tensile Ratio (based on R_{10.5});
- Pipe Elongation;
- Charpy Impact Results;
- Hardness Tests;
- Heat Treatment Condition
- Hydrostatic Test Certificate, or statement;
- NDT Procedures and Results;
- Surface Inspection;
- Dimensional Control Checks;
- Manufacturing Procedure Specification and Qualification Tests;
- Hardness test and CTOD test records;
- Information on production & shipping

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- All other reports and results as required as per this specification
- NDT Operator Qualification Certificates;
- Inspection certificate issued and validated by Authorized representative of Purchaser, as per “3.1C” of ISO 10474 : 1991, in accordance with this specification.
- COMPANY Authorized representative’s Pipe Inspection and Release Note.

Such documents shall indicate pipe identification number, the origin of each individual test specimen etc. and shall be written in English only. International system of units (SI) shall be adopted. The certificates shall be valid only when signed by Company Representative. Only those pipes which have been certified by Company Representative shall be dispatched from the pipe mill.

Manufacturer shall also provide information on test failure / rejected heats etc.

10.2 Specific Inspection

10.2.1 Inspection frequency

10.2.1.2 AMEND

The inspection frequency shall be as given in Table 18 of API 5L, 45th Edition modified by Table J.6 of API 5L, 45th Edition and Table J.6 (Amended) of this Specification.

10.2.2 Samples and test pieces for product analysis.

ADD

Product analysis shall be carried out from finished pipes.


10.2.3 Samples and test pieces for mechanical tests.

SUBSTITUTE

10.2.3.1 For tensile tests, CVN impact tests and CTOD tests, the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in J.8 of this specification,

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taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4. and J.8.2.2.

10.2.6 Hydrostatic Test

10.2.6.1 SUBSTITUTE

The test pressure for all sizes and grades of pipes shall not be less than the maximum pressure calculated based on either of the criteria mentioned at 10.2.6.5 (amended) and 10.2.6.6 (amended) .The test pressure shall be held for a minimum period of 10 seconds for all sizes and grades of pipes.

10.2.6.2 AMEND

The Test pressure measuring device used for hydrostatic testing shall be calibrated with a Dead Weight tester and the record shall be maintained. Calibration records shall be furnished to Company Representative. The calibration shall be conducted at start of a run and after a hydrostatic burst/leak failure

10.2.6.5 AMEND

The required test pressure shall produce a hoop stress of at least 90% of the specified minimum yield strength for all the grades and sizes.

10.2.6.6 AMEND

In case, pressure testing involves end sealing ram, the required test pressure shall produce a hoop stress of at least 95% of the specified minimum yield strength for all the grades and size.

10.2.7 Visual Inspection

10.2.7.1 AMEND


Each pipe shall be visually inspected to detect surface defects, with an illuminance of at least 300 lx (28 fc). Such inspection shall be over the entire external surface and shall cover as much of the internal surface as is practical.

10.2.7.2 DELETE

10.2.7.4 AMEND

Maximum hardness in suspected hard spots shall be 250 HV10. Sections of pipes where hardness is greater than the allowable value shall be cut off as per requirements of API 5L para C.3.b) or C.3.c) of Annex C.

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10.2.8 Dimensional testing

10.2.8.1 ADD

Caliper / properly sized go-no-go gauges shall be used to verify that diameter and out of roundness at pipe ends for each pipe is within the required tolerances J.6.1 of API 5L.

10.2.8.5 AMEND

The wall thickness at any location shall be within the tolerances specified in para 9.11.3.2 of this specification.

10.2.10 SUBSTITUTE

Non-destructive inspections shall be in accordance with Annex K (Amended).

10.2.11 SUBSTITUTE

Reprocessing is not permitted.

10.2.12 Retesting (SUBSTITUTE)

10.2.12.1 Recheck Analysis

If any parts of the full product analysis on any one of the fully analyzed pipes fail to meet the requirements of J.4.1 of this specification, either the whole heat shall stand rejected or each individual pipe shall be fully analyzed and all pipes failing to meet the requirements of J.4.1 of this specification shall be rejected.


10.2.12.2, 10.2.12.6 & 10.2.6.7

Tensile retest, Charpy retest and Hardness retest

In case one of the test specimens fails to conform to the specified requirements, a retest on four additional pipes from the same lot shall be made. If all re-tests give positive result, then the pipe, which gave the negative result, shall be rejected and the balance lot shall be accepted.

In case of negative result of one of the re-test specimens, the lot may be rejected or each of the remaining lengths shall be tested individually. The pipes, which give results as per requirement of this specification, shall only be accepted.

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11.2 Pipe markings

11.2.1 ADD

Marking shall be in English using SI units. Markings shall also include API monogram, purchase order number, item number, heat number, wall thickness (mm), pipe number, weight and grade. Weight marked shall be the actual weight of the pipe.

12. Coatings and thread protectors

12.1.2 AMEND

Pipe shall be delivered with mill's standard temporary external coating throughout the external surface of pipe body to provide protection from rusting in storage and transit.

12.3 Bevel Protectors (New)

Both pipe ends of all pipes shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard

13 Retention of Records

ADD

In addition to the records indicated in clause 13, the manufacturer shall retain the records of all additional tests mentioned in this specification including the ultrasonic testing carried out on pipe as well as pipe ends.

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ANNEXUREES OF API 5L(AMENDED)

ANNEXURES	Service
Annex B (Amended) - Manufacturing procedure qualification for PSL 2 pipe	Offshore Service
Annex C (Amended) - Treatment of surface imperfections and defects	Offshore Service
Annex J (Amended) - PSL 2 pipe ordered for offshore service	Offshore Service
Annex K (Amended)- Non-destructive inspection for pipe ordered for sour service and/or offshore service	Offshore Service

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Annex B (AMENDED)

Manufacturing Procedure Qualification for PSL 2 Pipe

B1.3 (Amend)

Verification of manufacturing procedure qualification shall be carried out in accordance with the fulfilment of Clause B.3, B.4 & B.5 of this specification.

B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION


SUBSTITUTE

A Manufacturing Procedure Specification (MPS) outlining the successive steps and associated inspection procedures from steelmaking to finished line pipe shall be prepared and submitted to Purchaser for approval prior to start of production. Manufacture of pipes shall start only after the approval of Manufacturing Procedure. The approved Manufacturing Procedure shall be strictly followed in all phases of the production of pipes.

The Manufacturing Procedure shall as a minimum include the following information:

- Steel maker and plant at which billet is produced.
- Type of Furnace, Equipment and process description including steel making process with details of secondary refining process and continuous casting process, nominal weight of each heat, deoxidation practices and inclusion shape control practices.
- Target chemistry, range of intentionally added elements and those listed in Table J.1 of API 5L, 45th Edition, limits on heat and product analysis to be placed on steel maker.
- Steelmaking and casting process control.
- Hydrogen control practices for billets.
- Product identification and traceability practices;
- Product rework/retest/release controls for non-conformances to manufacturer's documented practices including grade intermixes/transitions and process/chemistry deviations;
- Centerline segregation controls and acceptance criteria, as applicable.
- name/location of pipe manufacturing facility.
- equipment and process description of pipe manufacturing facility;
- Heat treatment procedure document established as per para 8.12.
- Ultrasonic testing of pipes using automatic and manual equipment including details of equipment, techniques, scanning pattern, probe

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frequency, scanning sensitivity, reference standard for calibration, dynamic calibration procedure, method of marking defects and indicating loss of coupling, inspection and recording.

- NDT Procedures and Equipment Calibration
- Pipe making procedure including plate edge preparation, forming and any other special process proposed.
- Testing of chemical, mechanical and corrosion, macrographic and metallographic properties
- Dimensional tolerances, frequency of checking, measurement and record in a tabular form including details of instruments and equipment proposed.
- End cropping practices;
- Hydrostatic testing including details of testing equipment, procedure and the relevant test pressure calculations including calibration/verification of equipment.
- Marking, storage and transit protection coating procedures
- product traceability practices from billet receipt to pipe delivery;
- product rework/retest/release controls for non-conformances to manufacturer's documented
- practices (including process, chemical/ mechanical, and dimensional deviations),
- Handling, storage, loading and shipment procedure.
- Production report formats.
- Complete details of computerized pipe tracking system.
- Project specific quality control plan

B.5 Manufacturing procedure qualification tests (MPQT)


B.5.1 (Amend)

MPQT/ FIRST DAY PRODUCTION TESTS

The MPS shall be qualified for each pipe nominal diameter either as a part of first day production or as a separate MPQT prior to full scale production. Two lengths of completely finished pipes (in case of only one heat on first day) or two lengths from the first two heats i.e. one pipe from each heat (in case of more than one heat on first day) of first day's production shall be selected at random for testing to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The MPQT/ first day production tests shall be carried out on pipes as per requirement of para B.5.1 (Substituted) of this specification.

The MPQT/ first day's production tests shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser Representative

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The Manufacturer shall submit to Purchaser a report giving the results of all tests mentioned below. The report shall be agreed and signed by Purchaser Representative, prior to start of regular production.

The various tests to be conducted on each pipe shall be as follows. The test method and acceptance values shall be as per this specification unless specified differently in this Annexure.

a. Visual Examination

All pipes shall be examined visually for dimensional tolerances and apparent surface defects in accordance with 9, 10 & 11 respectively of this specification.

b. Mechanical Properties

The mechanical properties of all pipes shall be tested and shall meet the requirements of this specification. Purchaser Representative will select the places in pipe from where the test specimen shall be removed.

c. CTOD Test

CTOD testing shall be carried out in accordance with the requirements of BS7448:1991.

Two sets of specimen with each set consisting of three specimens shall be taken from the base metal with one set in longitudinal direction and other set in transverse direction. The test shall be carried out at 0 °C.

Minimum acceptable critical CTOD value shall be 0.2 mm for BM (Base Metal). Average CTOD values of BM shall be reported. In addition, all the data on fatigue pre-cracking front are required. (Crack length at the following positions i.e. both surfaces 25%, 50% and 75% of the specimen thickness, the minimum and the maximum angle between the crack and the plane of the notch).

d. In addition, all the remaining tests and inspections required to be conducted as per this specification shall be conducted on all the pipes selected for testing during first day production test.

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Annex C (AMENDED)

C.2 Treatment of surface imperfections and defects

C.2.3 Complete removal of defects shall be verified by local visual inspection, aided, where necessary, by suitable non-destructive inspection methods. To be acceptable, the diameter, out of roundness and wall thickness in the ground area shall be in accordance with 9.11.3.1 and 9.11.3.2 of this specification; further, the sum of all ground areas for surface defect treatment shall not exceed 10% of total internal and external surface area of each pipe.



Annex J (AMENDED)

PSL 2 pipe ordered for offshore service

J.2 Additional information to be supplied by the purchaser

Information Requirement

	Information sought by API 5L	COMPANY's Requirement
a)	steel casting method for strip or plate used for the manufacture of welded pipe (see J.3.3.2.1)	Not applicable
b)	ultrasonic inspection of strip or plate for laminar imperfections (see J.3.3.2.4)	Not applicable
c)	supply of helical-seam pipe containing coil/plate end welds (see J.3.3.2.5)	Not applicable
d)	chemical composition for intermediate grades (see J.4.1.1)	Not applicable
e)	chemical composition for pipe with $t > 25,0$ mm (0.984 in) (see J.4.1.2)	Table J.1 of API 5L shall be applicable. However, footnote g) of Table J.1 is not applicable.
f)	carbon equivalent limit for steel Grade L555QO or X80QO, L625QO or X90QO, and L690QO or X100QO (see Table J.1);	Not applicable
g)	Chemical composition limits [see Table J.1, footnote d]	Footnote d of Table J.1 of API 5L shall be applicable.
h)	Acceptance criteria for tensile properties if determined at other than room temperature (see J.4.2.2)	Not applicable
i)	for grades equal to or greater than Grade L555 or X80, a lower maximum tensile strength limit may be agreed [see Table J.2, footnote b)];	Not applicable
j)	Minimum average length other than 12,1 m (39.7 ft) and/or different range (see J.6.3)	Refer J.6.3 of API 5L.
k)	Diameter and out-of-roundness tolerances for SMLS pipe with $t > 25,0$ mm (0.984 in) [see Table J.3, footnote b)]	Tolerances shall be as per J.6.1 of API 5L.
l)	Use of inside diameter to determine diameter and out-of-roundness tolerances for non-expanded pipe with $D \geq 219,1$ mm	Acceptable



	(8.625 in) [see Table J.3, footnote c)]	
m)	hardness test of the pipe body seam weld and HAZ of EW and SAW pipe (see Table J.7);	Not applicable
n)	hardness testing of pipe body for SMLS pipe (see Table J.7);	Required
o)	CTOD testing (see J.8.2.2 and Table J.6);	Refer Annex B (Amended) within this specification.
p)	use of the ring expansion test for transverse yield strength determinations [see Table J.7, footnote c)];	Not applicable
q)	additional longitudinal tensile testing for deep-water pipelay [see Table J.7, footnote d)];	Not applicable
r)	deviation from hardness test [see J.8.3.2.2 c) and J.8.3.2.3];	Not Applicable
s)	deviation from location of hardness test [J.8.3.2.2.c)];	Not applicable
t)	for pipe with $t \geq 5,0$ mm (0.197 in), ultrasonic inspection for laminar imperfections within extended length of 100 mm (4.0 in) at the pipe ends (see K.2.1.3);	Applicable
u)	supplementary end NDT lamination criteria (see K.2.1.3 and K.2.1.4);	Refer K.2.1.3(Amended) and K.2.1.4 (Amended)
v)	magnetic particle inspection for laminar imperfections at each pipe end face/bevel (see K.2.1.4);	Refer K.2.1.4(Amended)
w)	ultrasonic inspection to verify conformance with the applicable requirements given in Table K.1 (see K.3.2.2);	Applicable; Refer K.3.2.2 (Amended).
x)	verification of lamination size/density (see K.3.2.2);	Applicable ; Refer K.3.2.2 (Amended).
y)	increased coverage for ultrasonic thickness measurements for SMLS pipe (see K.3.3);	Applicable; refer K.3.3 (amended).
z)	application of one or more of the supplementary non-destructive inspection operations for SMLS pipe (see K.3.4);	K.3.4(Amended) of this specification is applicable
aa)	ultrasonic inspection of SMLS pipe for the detection of transverse imperfections (see K.3.4.1);	K.3.4.1(Amended) is applicable




bb)	full-body inspection of SMLS pipe the flux leakage method for the detection of longitudinal and transverse imperfections (see K.3.4.2);	Either K.3.4.2 or K.3.4.3 is to be carried out. Refer Annex. K (Amended) of this Spec.
cc)	full-body inspection of SMLS pipe by the eddy current method (see .3.4.3);	Either K.3.4.2 or K.3.4.3 is to be carried out. Refer Annex. K (Amended) of this Spec.
dd)	full-body magnetic particle inspection of pipe (see K.3.4.4);	Not Applicable
ee)	Acceptance Level U2/U2H for non-destructive inspection of the weld seam of HFW pipe (see K.4.1);	Not applicable
ff)	alternate ISO 10893-10 HFW weld seam UT acceptance criteria [see K.4.1 b)];	Not applicable
gg)	ultrasonic inspection of the pipe body of HFW pipe for laminar imperfections (see K.4.2);	Not applicable
hh)	ultrasonic inspection of the strip/plate edges or areas adjacent to the weld for laminar imperfections (see K.4.3);	Not applicable
ii)	non-destructive inspection of the pipe body of HFW pipe using the ultrasonic or flux-leakage method (see K.4.4);	Not applicable
jj)	use of fixed-depth notches for equipment standardization [see K.5.1.1 c)];	Not applicable
kk)	radiographic inspection of the pipe ends (non-inspected pipe ends) and repaired areas [see K.5.3 a)];	Not applicable
ll)	magnetic particle inspection of the weld seam at the pipe ends of SAW pipe (see K.5.4).	Not applicable
m m)	for grades L625QO or X90QO, and L690QO or X100QO, a lower $Rt_{0.5}/R_m$ (see Table J.2).	Not applicable

J.3 Manufacturing

J.3.1 Manufacturing procedure

SUBSTITUTE

All pipes shall be manufactured in accordance with a manufacturing procedure that has been qualified in accordance with Annex B (Amended).

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J.3.3 Pipe manufacturing

J.3.3.1 SUBSTITUTE

Steel shall be made by continuous casting only. Cold expansion shall not be permitted for seamless pipes.

J.3.3.2 Not applicable

J.3.3.3 Joints

SUBSTITUTE

Joints are not permitted

J.4 ACCEPTANCE CRITERIA

J.4.2 Tensile properties

J.4.2.1 (Amend)

The ratio between yield strength and ultimate tensile strength of finished pipes shall not be more than 0.90.

J.4.2.2 DELETE

J.4.3 Hardness test (Amend)

For test pieces subjected to a hardness test the hardness in the pipe body, weld and HAZ shall be ≤ 250 HV10

J.6 Tolerances for diameter, wall thickness, length and straightness

J.6.2 SUBSTITUTE

Wall thickness tolerance for all sizes shall be +17.5%,-5%.Table J.4 shall not be applicable.

J.8 Inspection

J.8.1 Specific inspection

SUBSTITUTE

The frequency of inspection shall be as given in Table 18 of API 5L 45th Edition except as specifically modified in Table J.6 of API 5L 45th Edition and Table J.6 (Amended) of this specification.

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Table J.6- Inspection Frequency (Amended)

Type of Inspection	Frequency of inspection ^e
Product Analysis	Two pipes per heat of steel shall be analyzed for all elements listed in Table J.1 of API 5L, 45 Th Edition. When more than 100 pipes are manufactured from one heat, additional product analysis for one pipe shall be carried out for every 100 pipes or less of the same heat.
Hardness testing of the pipe body of pipe with $D < 508$ mm (20.000 in)	Once per test unit of not more than 100 lengths of pipe with the same cold expansion ratio ^a
Pipe diameter and out-of-roundness	Once per test unit of not more than 20 lengths of pipe
Non-destructive inspection	In accordance with Annex K (Amended)
CTOD test for pipe of all Grades	As per Annex B (Amended) of this specification..
Mill Qualification and First Day Production Test	Manufacturing Procedure Qualification test (MPQT) / First Day Production Test As per Annex B (Amended) of this specification.

J.8.2 Samples and test pieces for mechanical and technological tests.

SUBSTITUTE

J.8.2.1.1 For tensile tests, CVN impact tests, CTOD tests the samples shall be taken and the corresponding test pieces shall be prepared, in accordance with the applicable reference standard.

J.8.2.1.2 Samples and test pieces for the various test types shall be taken from locations as shown in Figure 5 a) and as given in Table J.8 taking into account the supplementary details in 10.2.3.2 to 10.2.3.3, 10.2.4 and J.8.2.2 of this specification.

Both transverse and longitudinal tensile test shall be carried out for each lot of 100 pipes or less, belonging to the same heat and manufactured by the same process. In case of pipe diameters i.e.



219.1 mm (8-5/8 inches) and smaller, transverse tensile test is not required.

J.8.2.2 Test Pieces for CTOD tests

SUBSTITUTE

Test pieces shall be taken from the parent metal and shall be prepared in accordance with ISO 12135, ASTM E1290, or BS 7448. The sampling procedure and position of test piece notches shall be as agreed.

J.8.3 Test method

J.8.3.1 CTOD Test


SUBSTITUTE

CTOD testing shall be carried out in accordance with the requirements of BS 7448. One set of three specimens shall be taken in transverse direction. However, in case of pipe OD \leq 219.1 mm; specimen may be taken in longitudinal direction. The test shall be carried out at 0°C. Minimum acceptable critical CTOD value shall be 0.2 mm. Average CTOD value shall be reported.

J.8.3.2 Hardness test

J.8.3.2.1 SUBSTITUTE

Vickers hardness tests as per ASTM E-92 shall be carried out on samples of pipes at locations indicated in Figure J.1 a) to establish that the hardness of the pipe material is less than 250 HV10. Testing frequency shall be same as for tensile tests as specified in 10.2.1.2 of this specification. Modalities of retest shall be in accordance with 10.2.12 of this specification.

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Annex K (AMENDED)

Non-destructive inspection for pipe ordered for sour service and / or offshore service.

K2.1.3 (AMEND)

Ultrasonic inspection with automated/semi-automated systems in accordance with ISO 10893-8 or by manual methods, as specified in Annex A of ISO 10893-8 shall be used to verify that 100mm wide zone at each pipe end is free of laminar defects.

K2.1.4 (AMEND)

The end face/bevel at each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 10893-5 or ASTM E709. Laminar imperfections > 6.4 mm (0.25 in) in the circumferential direction shall be classified as defects.

Residual magnetism after MPI shall not exceed 20Gauss measured by Hall Effect Gauss Meter.

K.3.2.1 & K.3.2.2 (AMEND)

Acceptance criteria for laminar imperfections shall be as per table K.1 for service condition "Sour, if agreed". The coverage during automatic inspection shall be 100% of the pipe surface.

K.3.3 (AMEND)

The coverage during inspection shall be 100% of the pipe surface.

K.3.4 (AMEND)

K.3.4.1 (Amend): SMLS pipe shall be ultrasonically inspected for the detection of transverse imperfections in accordance with 10893-10 acceptance level U2/C, or ASTM E213.

AND

Either requirement of K3.4.2 (Amend) OR K3.4.3 (Amend)

K.3.4.2 (Amend)

SMLS pipe shall be full body inspected using the flux leakage method in accordance with ISO 10893-3 acceptance level F2, or ASTM E570 for the detection of both longitudinal and transverse imperfections.

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K3.4.3 (Amend)

SMLS pipe shall be full body inspected for the detection of imperfections using the eddy current method in accordance with ISO 10893-2 acceptance level E2H/E2, or ASTM E309.

K3.4.4 (Amend)

Full body magnetic particle inspection of SMLS pipes is NOT required.