

API 5L

Specification for Line Pipe

This Standard specifies requirements for the manufacture of two product specification levels (PSL 1 and PSL 2) of seamless and welded steel pipes for use in pipeline transportation systems in the petroleum and natural gas industries.

This Standard is not applicable to cast pipe.

A. Manufacturing :-

- Pipe furnished to this Standard shall be manufactured in accordance with the applicable requirements and limitations given in Tables 1 and 2.

Tables 1 — Acceptable processes of manufacture and product specification levels

Type of pipe or pipe end	PSL 1 pipe grade a					PSL 2 pipe grade a		
	L175 or A25 b	L175P or A25P b	L210 or A	L245 or B	L290 or X42 to L485 or X70	L245 or B to L555 or X80	> L555 or X80 to L690 or X100	>L690 or X100 to L830 or X120
Type of pipe								
SMLS	X	X	X	X	X	X	X	—
CW	X	X	—	—	—	—	—	—
LFW	X	—	X	X	X	—	—	—
HFW	X	—	X	X	X	X	—	—
LW	—	—	—	—	X	—	—	—
SAWL c	—	—	X	X	X	X	X	X
SAWH d	—	—	X	X	X	X	X	X
COWL c	—	—	X	X	X	X	—	—
COWH d	—	—	X	X	X	X	—	—
Type of pipe end								
Belled end e	X	—	X	X	X	—	—	—
Plain end	X	—	X	X	X	X	X	X
Plain end for special coupling	X	—	X	X	—	—	—	—
Threaded end f	X	X	X	X	—	—	—	—

a Intermediate grades are available if agreed, but limited to grades higher than Grade L290 or X42.

b Grades L175, L175P, A25 and A25P are limited to pipe with $D \leq 141,3$ mm (5.563 in).

c Double-seam pipe is available if agreed, but limited to pipe with $D \geq 914$ mm (36.000 in).

d Helical-seam pipe is limited to pipe with $D \geq 114,3$ mm (4.500 in).

e Belled-end pipe is limited to pipe with $D \leq 219.1$ mm (8.625 in) and $t \leq 3,6$ mm (0.141 in).

f Threaded-end pipe is limited to SMLS and longitudinal seam welded pipes with $D \leq 508$ mm (20.000 in).

Tables 2 — Acceptable manufacturing routes for PSL 2 pipe

Type of pipe	Starting material	Pipe forming	Pipe heat treatment	Delivery condition
SMLS	Ingot, bloom or billet	As-rolled	—	R
		Normalizing forming	—	N
		Hot forming	Normalizing	N
		Hot forming and cold finishing	Quenching and tempering	Q
			Normalizing	N
HFW	Normalizing-rolled coil	Cold forming	Heat treating ^a of weld area only	N
	Thermo-mechanical-rolled coil	Cold forming	Heat treating ^a of weld area only	M
			Heat treating ^a of weld area and stress relieving of entire pipe	M
	As-rolled or thermo-mechanical-rolled coil	Cold forming	Normalizing	N
		Cold forming followed by hot reducing under controlled temperature resulting in a normalized condition	Quenching and tempering	Q
			—	N
			—	M
SAW or COW pipe	Normalized or normalizing rolled coil or plate	Cold forming	—	N
	As-rolled, thermo-mechanical-rolled, normalizing-rolled or normalized	Cold forming	Normalizing	N
	Thermo-mechanical-rolled coil or plate	Cold forming	—	M
	Quenched and tempered plate	Cold forming	—	Q
	As-rolled, thermo-mechanical-rolled, normalizing-rolled or normalized coil or plate	Cold forming	Quenching and tempering	Q
	As-rolled, thermo-mechanical-rolled, normalizing-rolled or normalized coil or plate	Normalizing forming	—	N

^a Treatment of weld seams in EW and LW pipes :-

PSL 1 EW pipe:

For grades higher than Grade L290 or X42, the weld seam and the HAZ shall be heat treated so as to simulate a normalizing heat treatment, except that, if agreed, alternative heat treatments may be substituted.

For grades equal to or lower than Grade L290 or X42, the weld seam shall be heat treated so as to simulate a normalizing heat treatment, or the pipe shall be processed in such a manner that no untempered martensite remains.

LW pipe and PSL 2 HFW pipe:

For all grades, the weld seam and the entire HAZ shall be heat treated so as to simulate a normalizing heat treatment.

B. Chemical composition :-

1. For PSL 1 pipe with $t \leq 25.0$ mm (0.984 in), the chemical composition for standard grades shall be as given in Table 4, and the chemical composition for intermediate grades shall be as agreed, but consistent with those given in Table 3.
2. For PSL 2 pipe with $t \leq 25.0$ mm (0.984 in), the chemical composition for standard grades shall be as given in Table 5 and the chemical composition for intermediate grades shall be as agreed, but consistent with those given in Table 5.
3. For PSL 1 or PSL 2 pipe with $t > 25.0$ mm (0.984 in), the chemical composition shall be agreed, with the requirements of Tables 3 and 4 being amended as appropriate.

Table 3 — Chemical composition for PSL 1 pipe with $t \leq 25.0$ mm (0.984 in)

Steel grade (Steel name)	Mass fraction, based upon heat and product analyses ^{a, g}							
	C max. ^b	Mn max. ^b	P min.	P max.	S max.	V max.	Nb max.	Ti max.
Seamless pipe								
L175 or A25	0.21	0.6	—	0.03	0.03	—	—	—
L175P or A25P	0.21	0.6	0.045	0.08	0.03	—	—	—
L210 or A	0.22	0.9	—	0.03	0.03	—	—	—
L245 or B	0.28	1.2	—	0.03	0.03	c,d	c,d	d
L290 or X42	0.28	1.3	—	0.03	0.03	d	d	d
L320 or X46	0.28	1.4	—	0.03	0.03	d	d	d
L360 or X52	0.28	1.4	—	0.03	0.03	d	d	d
L390 or X56	0.28	1.4	—	0.03	0.03	d	d	d
L415 or X60	0.28 ^e	1.40 ^e	—	0.03	0.03	f	f	f
L450 or X65	0.28 ^e	1.40 ^e	—	0.03	0.03	f	f	f
L485 or X70	0.28 ^e	1.40 ^e	—	0.03	0.03	f	f	f
Welded pipe								

L175 or A25	0.21	0.6	—	0.03	0.03	—	—	—
L175P or A25P	0.21	0.6	0.045	0.08	0.03	—	—	—
L210 or A	0.22	0.9	—	0.03	0.03	—	—	—
L245 or B	0.26	1.2	—	0.03	0.03	c,d	c,d	d
L290 or X42	0.26	1.3	—	0.03	0.03	d	d	d
L320 or X46	0.26	1.4	—	0.03	0.03	d	d	d
L360 or X52	0.26	1.4	—	0.03	0.03	d	d	d
L390 or X56	0.26	1.4	—	0.03	0.03	d	d	d
L415 or X60	0.26 ^e	1.40 ^e	—	0.03	0.03	f	f	f
L450 or X65	0.26 ^e	1.45 ^e	—	0.03	0.03	f	f	f
L485 or X70	0.26 ^e	1.65 ^e	—	0.03	0.03	f	f	f

^a Cu ≤ 0.50 %; Ni ≤ 0.50 %; Cr ≤ 0.50 % and Mo ≤ 0.15%

^b For each reduction of 0.01 % below the specified maximum concentration for carbon, an increase of 0.05 % above the specified maximum concentration for Mn is permissible, up to a maximum of 1.65 % for grades ≥ L245 or B, but ≤ L360 or X52; up to a maximum of 1.75 % for grades > L360 or X52, but < L485 or X70; and up to a maximum of 2.00 % for grade L485 or X70.

^c Unless otherwise agreed, Nb + V ≤ 0.06 %.

^d Nb + V + Ti ≤ 0.15 %.

^e Unless otherwise agreed.

^f Unless otherwise agreed, Nb + V + Ti ≤ 0.15 %.

^g No deliberate addition of B is permitted and the residual B ≤ 0.001 %.

Table 4 — Chemical composition for PSL 2 pipe with $t \leq 25.0$ mm (0.984 in)

Steel grade (Steel name)	Mass fraction, based upon heat and product analyses % maximum									Carbon equivalent ^a % maximum	
	C ^b	Si	Mn ^b	P	S	V	Nb	Ti	Other	CE _{IIW}	CE _{Pcm}
Seamless and welded pipes											
L245R or BR	0.24	0.4	1.2	0.025	0.015	c	c	0.04	e,l	0.43	0.25
L290R or X42R	0.24	0.4	1.2	0.025	0.015	0.06	0.05	0.04	e,l	0.43	0.25

L245N or BN	0.24	0.4	1.2	0.025	0.015	c	c	0.04	e,l	0.43	0.25
L290N or X42N	0.24	0.4	1.2	0.025	0.015	0.06	0.05	0.04	e,l	0.43	0.25
L320N or X46N	0.24	0.4	1.4	0.025	0.015	0.07	0.05	0.04	d,e,l	0.43	0.25
L360N or X52N	0.24	0.45	1.4	0.025	0.015	0.1	0.05	0.04	d,e,l	0.43	0.25
L390N or X56N	0.24	0.45	1.4	0.025	0.015	0.10 ^f	0.05	0.04	d,e,l	0.43	0.25
L415N or X60N	0.24 ^f	0.45 ^f	1.40 ^f	0.025	0.015	0.10 ^f	0.05 ^f	0.04 ^f	g,h,l	as agreed	
L245Q or BQ	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L290Q or X42Q	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L320Q or X46Q	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L360Q or X52Q	0.18	0.45	1.5	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L390Q or X56Q	0.18	0.45	1.5	0.025	0.015	0.07	0.05	0.04	d,e,l	0.43	0.25
L415Q or X60Q	0.18 ^f	0.45 ^f	1.70 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25
L450Q or X65Q	0.18 ^f	0.45 ^f	1.70 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25
L485Q or X70Q	0.18 ^f	0.45 ^f	1.80 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25
L555Q or X80Q	0.18 ^f	0.45 ^f	1.90 ^f	0.025	0.015	g	g	g	i,j	as agreed	
L625Q or X90Q	0.16 ^f	0.45 ^f	1.9	0.02	0.01	g	g	g	j,k	as agreed	
L690Q or X100Q	0.16 ^f	0.45 ^f	1.9	0.02	0.01	g	g	g	j,k	as agreed	
Welded pipe											
L245M or BM	0.22	0.45	1.2	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L290M or X42M	0.22	0.45	1.3	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L320M or X46M	0.22	0.45	1.3	0.025	0.015	0.05	0.05	0.04	e,l	0.43	0.25
L360M or X52M	0.22	0.45	1.4	0.025	0.015	d	d	d	e,l	0.43	0.25
L390M or X56M	0.22	0.45	1.4	0.025	0.015	d	d	d	e,l	0.43	0.25
L415M or X60M	0.12 ^f	0.45 ^f	1.60 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25
L450M or X65M	0.12 ^f	0.45 ^f	1.60 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25
L485M or X70M	0.12 ^f	0.45 ^f	1.70 ^f	0.025	0.015	g	g	g	h,l	0.43	0.25

L555M or X80M	0.12 ^f	0.45 ^f	1.85 ^f	0.025	0.015	g	g	g	i,l	0.43 ^f	0.25
L625M or X90M	0.1	0.55 ^f	2.10 ^f	0.02	0.01	g	g	g	i,l	—	0.25
L690M or X100M	0.1	0.55 ^f	2.10 ^f	0.02	0.01	g	g	g	i,j	—	0.25
L830M or X120M	0.1	0.55 ^f	2.10 ^f	0.02	0.01	g	g	g	i,j	—	0.25

^a Based upon product analysis. For seamless pipe with $t > 20.0$ mm (0.787 in), the CE limits shall be as agreed. The CE_{ITW} limits apply if $C > 0.12$ % and the CE_{Pcm} limits apply if $C \leq 0.12$ %.

^b For each reduction of 0.01 % below the specified maximum for C, an increase of 0.05 % above the specified maximum for Mn is permissible, up to a maximum of 1.65 % for grades \geq L245 or B, but \leq L360 or X52; up to a maximum of 1.75 % for grades $>$ L360 or X52, but $<$ L485 or X70; up to a maximum of 2.00 % for grades \geq L485 or X70, but \leq L555 or X80; and up to a maximum of 2.20 % for grades $>$ L555 or X80.

^c Unless otherwise agreed, $Nb + V \leq 0.06$ %.

^d $Nb + V + Ti \leq 0.15$ %.

^e Unless otherwise agreed, $Cu \leq 0.50$ %; $Ni \leq 0.30$ %; $Cr \leq 0.30$ % and $Mo \leq 0.15$ %.

^f Unless otherwise agreed.

^g Unless otherwise agreed, $Nb + V + Ti \leq 0.15$ %.

^h Unless otherwise agreed, $Cu \leq 0.50$ %; $Ni \leq 0.50$ %; $Cr \leq 0.50$ % and $Mo \leq 0.50$ %.

ⁱ Unless otherwise agreed, $Cu \leq 0.50$ %; $Ni \leq 1.00$ %; $Cr \leq 0.50$ % and $Mo \leq 0.50$ %.

^j $B \leq 0.004$ %.

^k Unless otherwise agreed, $Cu \leq 0.50$ %; $Ni \leq 1.00$ %; $Cr \leq 0.55$ % and $Mo \leq 0.80$ %.

^l For all PSL 2 pipe grades except those grades to which footnote j already applies, the following applies. Unless otherwise agreed no intentional addition of B is permitted and residual $B \leq 0.001$ %.

C. Tensile properties :-

1. For PSL 1 pipe, the tensile properties shall be as given in Table 5.
2. For PSL 2 pipe, the tensile properties shall be as given in Table 6.

Table 5 — Requirements for the results of tensile tests for PSL 1 pipe

Pipe grade	Pipe body of seamless and welded pipes			Weld seam of EW, LW, SAW and COW pipes
	Yield strength ^a $R_{t0.5}$ MPa (psi) minimum	Tensile strength ^a R_m MPa (psi) Minimum	Elongation (on 50 mm or 2 in) A_f % minimum	Tensile strength ^b R_m MPa (psi) Minimum

L175 or A25	175 (25 400)	310 (45 000)	c	310 (45 000)
L175P or A25P	175 (25 400)	310 (45 000)	c	310 (45 000)
L210 or A	210 (30 500)	335 (48 600)	c	335 (48 600)
L245 or B	245 (35 500)	415 (60 200)	c	415 (60 200)
L290 or X42	290 (42 100)	415 (60 200)	c	415 (60 200)
L320 or X46	320 (46 400)	435 (63 100)	c	435 (63 100)
L360 or X52	360 (52 200)	460 (66 700)	c	460 (66 700)
L390 or X56	390 (56 600)	490 (71 100)	c	490 (71 100)
L415 or X60	415 (60 200)	520 (75 400)	c	520 (75 400)
L450 or X65	450 (65 300)	535 (77 600)	c	535 (77 600)
L485 or X70	485 (70 300)	570 (82 700)	c	570 (82 700)

a For intermediate grades, the difference between the specified minimum tensile strength and the specified minimum yield strength for the pipe body shall be as given in the table for the next higher grade.

b For intermediate grades, the specified minimum tensile strength for the weld seam shall be the same value as was determined for the pipe body using footnote a).

c The specified minimum elongation, A_f , expressed in percent and rounded to the nearest percent, shall be as determined using the following equation:

$$A_f = C [A_{xc}^{0.2} / U^{0.9}]$$

where

C is 1 940 for calculations using SI units and 625 000 for calculations using USC units;

A_{xc} is the applicable tensile test piece cross-sectional area, expressed in square millimetres (square inches), as follows:

— for circular cross-section test pieces, 130 mm² (0.20 in²) for 12.7 mm (0.500 in) and 8,9 mm (0.350 in) diameter test pieces; and 65 mm² (0.10 in²) for 6.4 mm (0.250 in) diameter test pieces;

— for full-section test pieces, the lesser of a) 485 mm² (0.75 in²) and b) the cross-sectional area of the test piece, derived using the specified outside diameter and the specified wall thickness of the pipe, rounded to the nearest 10 mm² (0.01 in²);

— for strip test pieces, the lesser of a) 485 mm² (0.75 in²) and b) the cross-sectional area of the test piece, derived using the specified width of the test piece and the specified wall thickness of the pipe, rounded to the nearest 10 mm² (0.01 in²);

U is the specified minimum tensile strength, expressed in megapascals (pounds per square inch).

Table 6 — Requirements for the results of tensile tests for PSL 2 pipe

Pipe grade	Pipe body of seamless and welded pipes	Weld seam of HFW, SAW and COW pipes
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	Yield strength ^a R _{t0.5} MPa (psi)		Tensile strength ^a R _m MPa (psi)		Ratio ^{a, c} R _{t0.5} /R _m	Elongation (on 50 mm or 2 in) A _f %	Tensile strength ^d R _m MPa (psi)
	minimum	maximum	minimum	maximum	maximum	minimum	Minimum
L245R or BR	245 (35 500)	450 ^e (65 300) ^e	415 (60 200)	655 (95 000)	0.93	f	415 (60 200)
L245N or BN							
L245Q or BQ							
L245M or BM							
L290R or X42R	290 (42 100)	495 (71 800)	415 (60 200)	655 (95 000)	0.93	f	415 (60 200)
L290N or X42N							
L290Q or X42Q							
L290M or X42M							
L320N or X46N	320 (46 400)	525 (76 100)	435 (63 100)	655 (95 000)	0.93	f	435 (63 100)
L320Q or X46Q							
L320M or X46M							
L360N or X52N	360 (52 200)	530 (76 900)	460 (66 700)	760 (110 200)	0.93	f	460 (66 700)
L360Q or X52Q							
L360M or X52M							
L390N or X56N	390 (56 600)	545 (79 000)	490 (71 100)	760 (110 200)	0.93	f	490 (71 100)
L390Q or X56Q							
L390M or X56M							
L415N or X60N	415 (60 200)	565 (81 900)	520 (75 400)	760 (110 200)	0.93	f	520 (75 400)
L415Q or X60Q							
L415M or X60M							
L450Q or X65Q	450 (65 300)	600 (87 000)	535 (77 600)	760 (110 200)	0.93	f	535 (77 600)
L450M or X65M							
L485Q or X70Q	485 (70 300)	635 (92 100)	570 (82 700)	760 (110 200)	0.93	f	570 (82 700)
L485M or X70M							
L555Q or X80Q	555 (80 500)	705 (102 300)	625 (90 600)	825 (119 700)	0.93	f	625 (90 600)
L555M or X80M							
L625M or X90M	625 (90600)	775 (112400)	695 (100800)	915 (132700)	0.95	f	695 (100800)

L625Q or X90Q	625 (90600)	775 (112400)	695 (100800)	915 (132700)	0.97 ^g	f	—
L690M or X100M	690 ^b (100100) ^b	840 ^b (121800) ^b	760 (110200)	990 (143600)	0.97 ^h	f	760 (110200)
L690Q or X100Q	690 ^b (100100) ^b	840 ^b (121800) ^b	760 (110200)	990 (143600)	0.97 ^h	f	—
L830M or X120M	830 ^b (120400) ^b	1050 ^b (152300) ^b	915 (132700)	1145 (166100)	0.99 ^h	f	915 (132700)

^a For intermediate grades, the difference between the specified maximum yield strength and the specified minimum yield strength shall be as given in the table for the next higher grade, and the difference between the specified minimum tensile strength and the specified minimum yield strength shall be as given in the table for the next higher grade. For intermediate grades up to Grade L320 or X46, the tensile strength shall be ≤ 655 MPa (95 000 psi). For intermediate grades greater than Grade L320 or X46 and lower than Grade L555 or X80, the tensile strength shall be ≤ 760 MPa (110 200 psi). For intermediate grades higher than Grade L555 or X80, the maximum permissible tensile strength shall be obtained by interpolation. For SI units, the calculated value shall be rounded to the nearest 5 MPa. For USC units, the calculated value shall be rounded to the nearest 100 psi.

^b For grades > L625 or X90, $R_{p0.2}$ applies.

^c This limit applies for pipe with $D > 323.9$ mm (12.750 in).

^d For intermediate grades, the specified minimum tensile strength for the weld seam shall be the same value as was determined for the pipe body using footnote a).

^e For pipe requiring longitudinal testing, the maximum yield strength shall be ≤ 495 MPa (71 800 psi).

^f The specified minimum elongation, A_f , shall be as determined using the following equation:

$$A_f = C [A_{xc}^{0.2} / U^{0.9}]$$

where

C is 1940 for calculations using SI units and 625 000 for calculations using USC units;

A_{xc} is the applicable tensile test piece cross-sectional area, expressed in square millimetres (square inches), as follows:

— for circular cross-section test pieces, 130 mm^2 (0.20 in^2) for 12.7 mm (0.500 in) and 8.9 mm (0.350 in) diameter test pieces; and 65 mm^2 (0.10 in^2) for 6.4 mm (0.250 in) diameter test pieces;

— for full-section test pieces, the lesser of a) 485 mm^2 (0.75 in^2) and b) the cross-sectional area of the test piece, derived using the specified outside diameter and the specified wall thickness of the pipe, rounded to the nearest 10 mm^2 (0.01 in^2);

— for strip test pieces, the lesser of a) 485 mm^2 (0.75 in^2) and b) the cross-sectional area of the test piece, derived using the specified width of the test piece and the specified wall thickness of the pipe, rounded to the nearest 10 mm^2 (0.01 in^2);

U is the specified minimum tensile strength, expressed in megapascals (pounds per square inch).

^g Lower values of $R_{t0.5}/R_m$ may be specified by agreement.

^h For grades > L625 or X90. $R_{p0.2}/R_m$ applies. Lower values of $R_{p0.2}/R_m$ may be specified by agreement.

D. Test methods :-

1. Tensile test:

- i. The tensile test shall be carried out in accordance with ISO 6892-1 or ASTM A370.

- ii. The percentage elongation after fracture shall be reported with reference to a gauge length of 50 mm (2 in). For test pieces having a gauge length less than 50 mm (2 in), the measured elongation after fracture shall be converted to a percentage elongation in 50 mm (2 in) in accordance with ISO 2566-1 or ASTM A370.
- 2. CVN impact test:
 - i. The Charpy test shall be carried out in accordance with ASTM A370 unless ISO 148-1.
- 3. Drop-weight tear test:
 - i. The drop-weight tear test shall be carried out in accordance with API RP 5L3.
- 4. Full section bend test:
 - i. The bend test shall be carried out in accordance with ISO 8491 or ASTM A370.
- 5. Guided-bend test:
 - i. The guided-bend test shall be carried out in accordance with ISO 7438 or ASTM A370.
- 6. Flattening test:
 - i. The flattening test shall be carried out in accordance with ISO 8492 or ASTM A370.
- 7. Hardness test:
 - i. When suspected hard spots are detected by visual inspection, hardness tests shall be carried out in accordance with ISO 6506, ISO 6507, ISO 6508 or ASTM A370 using portable hardness test equipment and methods complying with ASTM A956, ASTM A1038 or ASTM E110 respectively depending on the method used.
- 8. Macrographic and metallographic tests:
 - i. Except as allowed by point D.8.ii, the alignment of internal and external seams of SAW and COW pipes shall be verified by macrographic testing.
 - ii. Alternative methods, such as ultrasonic inspection, may be used if agreed, provided that the ability of such equipment to detect misalignment is demonstrated.
- 9. Hydrostatic test:
 - i. Test pressures for all sizes of SMLS pipe, and for welded pipe with $D \leq 457$ mm (18.000 in), shall be held for not less than 5 seconds.
 - ii. Test pressures for welded pipe with $D > 457$ mm (18.000 in) shall be held for not less than 10 seconds.
 - iii. For threaded-and-coupled pipe, the test shall be applied with the couplings made up power-tight if agreed, except that pipe with $D > 323.9$ mm (12.375 in) may be tested in the plain-end condition.
 - iv. Test pressures for light-wall threaded pipe shall be as given in Table 7.
 - v. Test pressures for heavy-wall threaded pipe shall be as given in Table 8.
- 10. Non-destructive inspection
 - i. Non-destructive inspection shall be in accordance with Annex E.

Table 7

Specified outside diameter D mm (in)	Specified wall thickness t mm (in)	Test pressure MPa (psi) minimum			
		L175 or A25	L175P or A25P	L210 or A	L245 or B
10.3 (0.405)	1.7 (0.068)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)
13.7 (0.540)	2.2 (0.088)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)
17.1 (0.675)	2.3 (0.091)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)
21.3 (0.840)	2.8 (0.109)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)

26.7 (1.050)	2.9 (0.113)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)
33.4 (1.315)	3.4 (0.133)	4.8 (700)	4.8 (700)	4.8 (700)	4.8 (700)
42.2 (1.660)	3.6 (0.140)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)
48.3 (1.900)	3.7 (0.145)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)
60.3 (2.375)	3.9 (0.154)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)
73.0 (2.875)	5.2 (0.203)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)
88.9 (3.500)	5.5 (0.216)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)	6.9 (1 000)
101.6 (4.000)	5.7 (0.226)	8.3 (1 200)	8.3 (1 200)	8.3 (1 200)	9.0 (1 300)
114.3 (4.500)	6.0 (0.237)	8.3 (1 200)	8.3 (1 200)	8.3 (1 200)	9.0 (1 300)
141.3 (5.563)	6.6 (0.258)	8.3 (1 200)	8.3 (1 200)	8.3 (1 200)	9.0 (1 300)
168.3 (6.625)	7.1 (0.280)	a	a	8.3 (1 200)	9.0 (1 300)
219.1 (8.625)	7.0 (0.277)	a	a	7.9 (1 160)	9.2 (1 350)
219.1 (8.625)	8.2 (0.258)	a	a	9.3 (1 340)	10.8 (1 570)
273.1 (10.750)	7.1 (0.280)	a	a	6.5 (940)	7.5 (1 090)
273.1 (10.750)	7.8 (0.307)	a	a	7.1 (1 030)	8.3 (1 200)
273.1 (10.750)	9.3 (0.365)	a	a	8.5 (1 220)	9.8 (1 430)
323.9 (12.750)	8.4 (0.330)	a	a	6.4 (930)	7.5 (1 090)
323.9 (12.750)	9.5 (0.375)	a	a	7.3 (1 060)	8.5 (1 240)
355.6 (14.000)	9.5 (0.375)	a	a	6.6 (960)	7.7 (1 130)
406.4 (16.000)	9.5 (0.375)	a	a	5.8 (840)	6.8 (980)
457 (18.000)	9.5 (0.375)	a	a	5.2 (750)	6.0 (880)
508 (20.000)	9.5 (0.375)	a	a	4.6 (680)	5.4 (790)

^a Not applicable.

Table 8

Specified outside diameter D mm (in)	Specified wall thickness t mm (in)	Test pressure MPa (psi) minimum			
		L175 or A25	L175P or A25P	L210 or A	L245 or B
10.3 (0.405)	2.4 (0.095)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)
13.7 (0.540)	3.0 (0.119)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)
17.1 (0.675)	3.2 (0.126)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)
21.3 (0.840)	3.7 (0.147)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)
26.7 (1.050)	3.9 (0.154)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)
33.4 (1.315)	4.5 (0.179)	5.9 (850)	5.9 (850)	5.9 (850)	5.9 (850)

42.2 (1.660)	4.9 (0.191)	9.0 (1 300)	9.0 (1 300)	10.3 (1 500)	11.0 (1 600)
48.3 (1.900)	5.1 (0.200)	9.0 (1 300)	9.0 (1 300)	10.3 (1 500)	11.0 (1 600)
60.3 (2.375)	5.5 (0.218)	9.0 (1 300)	9.0 (1 300)	17.0 (2 470)	17.0 (2 470)
73.0 (2.875)	7.0 (0.276)	9.0 (1 300)	9.0 (1 300)	17.0 (2 470)	17.0 (2 470)
88.9 (3.500)	7.6 (0.300)	9.0 (1 300)	9.0 (1 300)	17.0 (2 470)	17.0 (2 470)
101.6 (4.000)	8.1 (0.318)	11.7 (1 700)	11.7 (1 700)	19.0 (2 760)	19.0 (2 760)
114.3 (4.500)	8.6 (0.337)	11.7 (1 700)	11.7 (1 700)	18.7 (2 700)	19.0 (2 760)
141.3 (5.563)	9.5 (0.375)	11.7 (1 700)	11.7 (1 700)	16.7 (2 430)	19.0 (2 760)
168.3 (6.625)	11.0 (0.432)	a	a	16.2 (2 350)	18.9 (2 740)
219.1 (8.625)	12.7 (0.500)	a	a	14.4 (2 090)	16.8 (2 430)
273.1 (10.750)	12.7 (0.500)	a	a	11.6 (1 670)	13.4 (1 950)
323.9 (12.375)	12.7 (0.500)	a	a	9.7 (1 410)	11.3 (1 650)

^a Not applicable.

E. Annex :-

Non-destructive inspection for other than sour service or offshore service

1. Standard practices for inspection

Except as specifically modified in this annex, the required non-destructive inspection, other than for surface inspection and wall-thickness verification, shall be performed in accordance with one of the following standards or an equivalent:

- a) electromagnetic (flux leakage): ISO 10893-3 or ASTM E570;
- b) electromagnetic (eddy-current): ISO 10893-2 or ASTM E309;
- c) ultrasonic: ISO 10893-8, ISO 10893-9, ISO 10893-10, ASTM A435, ASTM A578 or ASTM E213;
- d) automated ultrasonic (weld seam): ISO 10893-11 or ASTM E273;
- e) manual ultrasonic (weld seam) : ISO 10893-11, ASTM E164, ASTM E587;
- f) magnetic particle: ISO 10893-5 or ASTM E709;
- g) radiographic (film): ISO 10893-6 or ASTM E94;
- h) radiographic (digital): ISO 10893-7, ASTM E2698, or ASTM E2033;
- i) liquid penetrant: ISO 10893-4 or ASTM E165.

- 2. For Grades \geq L210 or A, the weld seams of welded pipe with $D \geq 60.3$ mm (2.375 in) shall be non-destructively inspected, full length (100 %) for the entire thickness, as given in Table 9.
- 3. All PSL 2 SMLS pipe and PSL 1 Grade L245 or B quenched and tempered SMLS pipe shall be non-destructively inspected full length (100 %), as given in Table 10. If agreed, other PSL 1 SMLS pipe shall be non-destructively inspected as given in Table 10.

Table 9

Weld seam type	Non-destructive inspection method ^a		
	Electromagnetic	Ultrasonic	Radiographic
EW	one method or a combination of methods is required		not applicable
LW	not applicable	required	not applicable
SAW	not applicable	required ^b	if agreed
COW	not applicable	required	not applicable
Coil/plate end	not applicable	required ^b	if agreed

^a The weld seam at the pipe ends may require additional inspection.

^b Required unless the manufacturer and the purchaser have agreed to replace it by radiographic inspection.

Table 10

Item	Non-destructive inspection method		
	Electromagnetic	Ultrasonic	Magnetic particle (circular field)
PSL 2 pipe, any grade	one method or a combination of methods is required		
PSL 1 pipe, Grade L245 or B, quenched and tempered	one method or a combination of methods is required		
PSL 1 pipe, other than above	if agreed, one method or a combination of methods is required		

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