

## API 5L

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### Production Standard of API 5L

#### ● API 5L

API 5L is a standard specification for line pipe that which American Petroleum Institute (API) develops and it provides the requirements for the manufacture of two product levels ( API 5L PSL1 and API 5L PSL2) of seamless and welded steel pipe for the use of the global petroleum industry, especially in the transport of crude oil, natural gas, and water.

#### ● Dimensions and Sizes of API 5L

NPS		O. D.	W. T.														
D N	Inc h	mm	SCH 5S	SCH 10S	SCH 10	SCH 20	SCH 30	SCH 40	SCH 60	SCH 80	SCH 100	SCH 120	SCH 140	SCH 160	St h	XS	XXS
50	2"	60.3	1.65	2.77	-	-	-	3.91	-	5.54	-	-	-	8.74	3.91	5.54	11.07
65	2 1/2"	73	2.11	3.05	-	-	-	5.16	-	7.01	-	-	-	9.53	5.16	7.01	14.02

80	3"	88.9	2.11	3.05	-	-	-	5.49	-	7.62	-	-	-	11.13	5.49	7.52	15.24
90	3 1/2"	101.6	2.11	3.05	-	-	-	5.74	-	8.08	-	-	-	-	5.74	8.08	-
100	4"	114.3	2.11	3.05	-	-	-	6.02	-	8.58	-	11.13	-	13.49	6.02	8.56	17.12
125	5"	141.3	2.77	3.4	-	-	-	6.55	-	9.53	-	12.7	-	15.88	6.55	9.53	18.05
150	6"	168.3	2.77	3.4	-	-	-	7.11	-	10.97	-	14.27	-	18.26	7.11	10.97	21.95
200	8"	219.1	2.77	3.76	-	6.35	7.04	8.18	10.31	12.7	15.09	18.26	20.62	23.01	8.18	12.7	22.23
250	10"	273.1	3.4	4.19	-	6.35	7.8	9.27	12.7	15.09	18.26	21.44	25.4	28.58	9.27	12.7	25.4
300	12"	323.9	3.96	4.57	-	6.35	8.38	10.31	14.27	17.48	21.44	25.4	28.58	33.32	9.53	12.7	25.4
350	14"	355.5	3.96	4.78	6.35	7.92	9.53	11.13	15.09	19.05	23.83	27.79	31.75	35.71	9.53	12.7	-
400	16"	406.4	4.19	4.78	6.35	7.92	9.53	12.7	16.66	21.44	26.19	30.96	36.53	40.49	9.53	12.7	-
450	18"	457.2	4.19	4.78	6.35	7.92	11.13	14.27	19.05	23.83	39.36	34.93	39.67	45.24	-	-	-
500	20"	508	4.78	5.54	6.35	9.53	12.7	15.09	20.62	26.19	32.54	38.1	44.45	50.01	-	-	-
550	22"	558.8	4.78	5.54	6.35	9.53	12.7	-	22.23	28.58	34.93	41.28	47.63	53.98	-	-	-
600	24"	609.6	5.54	6.35	6.35	9.53	14.27	17.48	24.61	30.96	38.89	46.02	52.37	59.54	-	-	-

## ●Chemical Composition of API 5L

### - API 5L PSL 1 Chemical Component

Steel Grade	Mass fraction, % based on heat and product analyses a,g						
	C	Mn	P	S	V	Nb	Ti
	max b	max b	max	max	max	max	max
<b>Seamless Pipe</b>							
A	0.22	0.9	0.03	0.03	–	–	–
B	0.28	1.2	0.03	0.03	c,d	c,d	d
X42	0.28	1.3	0.03	0.03	d	d	d
X46	0.28	1.4	0.03	0.03	d	d	d
X52	0.28	1.4	0.03	0.03	d	d	d
X56	0.28	1.4	0.03	0.03	d	d	d
X60	0.28 e	1.40 e	0.03	0.03	f	f	f
X65	0.28 e	1.40 e	0.03	0.3	f	f	f
X70	0.28 e	1.40 e	0.03	0.03	f	f	f
<b>Welded Pipe</b>							
A	0.22	0.9	0.03	0.03	–	–	–
B	0.26	1.2	0.03	0.03	c,d	c,d	d
X42	0.26	1.3	0.03	0.03	d	d	d
X46	0.26	1.4	0.03	0.03	d	d	d
X52	0.26	1.4	0.03	0.3	d	d	d
X56	0.26	1.4	0.3	0.03	d	d	d
X60	0.26 e	1.40 e	0.03	0.03	f	f	f
X65	0.26 e	1.45 e	0.03	0.03	f	f	f
X70	0.26e	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%

## - API 5L PSL 2 Chemical Component

Steel Grade	Mass fraction, % based on heat and product analyses									Carbon Equiv a	
	C	Si	Mn	P	S	V	Nb	Ti	Other	CE IIW	CE Pcm
	max b	max	max b	max	max	max	max	max		max	max
<b>Seamless Pipe</b>											
BR	0.24	0.4	1.2	0.025	0.015	c	c	0.04	e,l	0.043	0.25
X42R	0.24	0.4	1.2	0.025	0.015	0.06	0.05	0.04	e,l	0.043	0.25
BN	0.24	0.4	1.2	0.025	0.015	c	c	0.04	e,l	0.043	0.25
X42N	0.24	0.4	1.2	0.025	0.015	0.06	0.05	0.04	e,l	0.043	0.25
X46N	0.24	0.4	1.4	0.025	0.015	0.07	0.05	0.04	d,e,l	0.043	0.25
X52N	0.24	0.45	1.4	0.025	0.015	0.1	0.05	0.04	d,e,l	0.043	0.25
X56N	0.24	0.45	1.4	0.025	0.015	0.10f	0.05	0.04	d,e,l	0.043	0.25
X60N	0.24f	0.45f	1.40f	0.025	0.015	0.10f	0.05f	0.04f	g,h,l	As agreed	
BQ	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X42Q	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X46Q	0.18	0.45	1.4	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X52Q	0.18	0.45	1.5	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X56Q	0.18	0.45f	1.5	0.025	0.015	0.07	0.05	0.04	e,l	0.043	0.25
X60Q	0.18f	0.45f	1.70f	0.025	0.015	g	g	g	h,l	0.043	0.25
X65Q	0.18f	0.45f	1.70f	0.025	0.015	g	g	g	h,l	0.043	0.25
X70Q	0.18f	0.45f	1.80f	0.025	0.015	g	g	g	h,l	0.043	0.25
X80Q	0.18f	0.45f	1.90f	0.025	0.015	g	g	g	i,j	As agreed	
X90Q	0.16f	0.45f	1.9	0.02	0.01	g	g	g	j,k	As agreed	
X100Q	0.16f	0.45f	1.9	0.02	0.01	g	g	g	j,k	As agreed	
<b>Welded Pipe</b>											
BM	0.22	0.45	1.2	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X42M	0.22	0.45	1.3	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X46M	0.22	0.45	1.3	0.025	0.015	0.05	0.05	0.04	e,l	0.043	0.25
X52M	0.22	0.45	1.4	0.025	0.015	d	d	d	e,l	0.043	0.25
X56M	0.22	0.45f	1.4	0.025	0.015	d	d	d	e,l	0.043	0.25
X60M	0.12f	0.45f	1.60f	0.025	0.015	g	g	g	h,l	0.043	0.25

X65M	0.12f	0.45f	1.60f	0.025	0.015	g	g	g	h,l	0.043	0.25
X70M	0.12f	0.45f	1.70f	0.025	0.015	g	g	g	h,l	0.043	0.25
X80M	0.12f	0.45f	1.85f	0.025	0.015	g	g	g	i,j	.043f	0.25
X90M	0.1	0.55f	2.10f	0.02	0.01	g	g	g	i,j	–	0.25
X100M	0.1	0.55f	2.10f	0.02	0.01	g	g	g	i,j	–	0.25

- a. SMLS  $t > 0.787"$ , CE limits shall be as agreed. The CEIIW limits applied if  $C > 0.12\%$  and the CEPcm 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 with footnotes j noted, the following applies. Unless otherwise agreed no intentional addition of B is permitted and residual  $B \leq 0.001\%$ .

## ●Mechanical Properties Tensile Strength and Yield Strength of API 5L

### - API 5L PSL-1 Mechanical Properties

Pipe Grade	Pipe body of seamless and welded pipes			Weld seam of EW, SAW and COW pip
	Yield strength R10,5MPa(psi) minimum	Tensile strength RmMPa(psi) minimum	Elongation Af% minimum	Tensile strength RmMPa(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)

L245R or BR L245 or B	245 (35 500)	415 (60 200)	c	415 (60 200)
L290R or X42R 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;

$$A_f = C \frac{A_{xc}^{0,2}}{U^{0,9}}$$

Api-Af

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 millimeters (square inches), as follows:

— for circular cross-section test pieces, 130 mm<sup>2</sup> (0.20 in<sup>2</sup>) for 12,5 mm (0.500 in) and 8,9 mm (0.350 in) diameter test pieces; and 65 mm<sup>2</sup>(0.10 in<sup>2</sup>) for 6,4 mm (0.250 in) diameter test pieces;

— For full-section test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) 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<sup>2</sup> (0.01 in<sup>2</sup>);

— for strip test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) 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<sup>2</sup>(0.01 in<sup>2</sup>);

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

## - API 5L PSL-2 Mechanical Properties

Pipe grade	Pipe body of seamless and welded pipes						Weld seam of HFW, SAW and COW pipes
	Yield strength		Tensile strength		Ratio a,b,c	Elongation	Tensile strength
	R <sub>t0,5b</sub>		R <sub>m</sub>		R <sub>t0,5</sub> /R <sub>m</sub>	A <sub>f</sub>	R <sub>m</sub>
	MPa (psi)		MPa (psi)			%	MPa (psi)
	min.	max.	min.	max.	max.	min.	min.
L245R or BR	245	450 e	415	760	0,93	f	415
L245N or BN	(35 500)	(65 300) e	(60 200)	(110 200)			(60 200)
L245Q or BQ							
L245M or BM							
L290R or X42R	290	495	415	760	0,93	f	415
L290N or X42N	(42 100)	(71 800)	(60 200)	(110 200)			(60 200)
L290Q or X42Q							
L290M or X42M							
L320N or X46N	320	525	435	760	0,93	f	435
L320Q or X46Q	(46 400)	(76 100)	(63 100)	(110 200)			(63 100)
L320M or X46M							
L360N or X52N	360	530	460	760	0,93	f	460
L360Q or X52Q	(52 200)	(76 900)	(66 700)	(110 200)			(66 700)
L360M or X52M							
L390N or X56N	390	545	490	760	0,93	f	490

L390Q or X56Q	(56 600)	(79 000)	(71 100)	(110 200)			(71 100)
L390M or X56M							
L415N or X60N	415	565	520	760			520
L415Q or X60Q	(60 200)	(81 900)	(75 400)	(110 200)	0,93	f	(75 400)
L415M or X60M							
L450Q or X65Q	450	600	535	760			535
L450M or X65M	(65 300)	(87 000)	(77 600)	(110 200)	0,93	f	(77 600)
L485Q or X70Q	485	635	570	760			570
L485M or X70M	(70 300)	(92 100)	(82 700)	(110 200)	0,93	f	(82 700)
L555Q or X80Q	555	705	625	825			625
L555M or X80M	(80 500)	(102 300)	(90 600)	(119 700)	0,93	f	(90 600)
L625M or X90M	625	775	695	915			695
	(90 600)	(112 400)	(100 800)	(132 700)	0,95	f	(100 800)
L690M or X100M	690	840	760	990			760
	(100 100)	(121 800)	(110 200)	(143 600)	0,97 g	f	(110 200)
L830M or X120M	830	1 050	915	1 145			915
	(120 400)	(152 300)	(132 700)	(166 100)	0,99 g	f	(132 700)

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 lower than Grade L555 or X80, the tensile strength shall be  $\leq 760$  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, Rp0,2 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 with D <219,1 mm (8.625 in), the maximum yield strength shall be  $\leq 495$  MPa (71 800 psi).



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

$$A_f = C \frac{A_{xc}^{0,2}}{U^{0,9}}$$

Api 5L  $A_f$

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 millimeters (square inches), as follows:

— for circular cross-section test pieces, 130 mm<sup>2</sup> (0.20 in<sup>2</sup>) for 12,5 mm (0.500 in) and 8,9 mm (0.350 in) diameter test pieces; and 65 mm<sup>2</sup> (0.10 in<sup>2</sup>) for 6,4 mm (0.250 in) diameter test pieces;

— for full-section test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) 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<sup>2</sup> (0.01 in<sup>2</sup>)

— for strip test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) 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 API 5L pipe, rounded to the nearest 10 mm<sup>2</sup> (0.01 in<sup>2</sup>);

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