

# CARBON STEEL PIPE



# CARBON STEEL PIPE ASTM A106/A53/API 5L PSL1, PSL2 ANSI/ASME B36.10

## Scope

**ASTM A53** is Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

**ASTM A106** is Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

**API 5L** is Specification for Line Pipe.

**PSL1,2** stands for Product Specification Levels.

## Application

A 53 is a general steel pipe spec which covers galvanized pipe and black pipe. It is available in Type S (seamless), Type E (ERW, electric resistance welded longitudinal seam), and Type F (furnace welded).

A106 Gr. B is intended for high temperature service (up to 750 Deg F). It just applies to **seamless steel pipe** with killed steel. Pipe of NPS 1 1/2" and under may be either hot finished or cold drawn. Unless specified, pipe on and over NPS 2" shall be furnished hot finished, while A53 and API 5L are not.

API 5L Gr. B (PSL-1) is mainly developed for Line pipes used in conveying gas, oil, and water in oil and gas industry.

Our pipes meet the latest chemistry standards from ASME.

## Chemical compositions

Standard	Grade	Chemical Composition %									
		C	Mn	P	S	Si	Cr	Cu	Ni	Mo	V
ASTM A106	B	≤0.30	0.29-1.06	≤0.035	≤0.035	>0.10	≤0.40	≤0.40	≤0.40	≤0.15	≤0.08
ASTM A53	B	≤0.30	≤1.20	≤0.05	≤0.045	–	≤0.40	≤0.40	≤0.40	≤0.15	≤0.08
API 5L	B(PSL1)	≤0.28	≤1.20	≤0.030	≤0.030	–	–	–	–	–	–

PARAMETER	PSL1	PSL2
Max C for Seamless pipe	0.28% for grades ≥ B	0.0024
Max P	0.03% for grades ≥ A	0.0003
Max S	0.0003	0.0002
Carbon equivalent:	Only when purchaser specifies SR18	–

Three elements change when requirements change from PSL1 to PSL2.

### The first is Carbon.

Maximum Carbon for Seamless PSL1 pipe is 0.28% for grade B & higher. For all grades of PSL2 pipes maximum carbon is 0.24%.

Similarly, for welded PSL1 pipe Maximum Carbon is 0.26% for grade B & higher. For all grades of PSL2 welded pipes maximum carbon is 0.22%.

### The second element is Phosphorus.

For PSL1 pipe, Maximum Phosphorus is 0.03% for the grade A & higher. For all grades of PSL2 pipes, the maximum Phosphorus is 0.03%. So, the only difference is a grade lower than A.

### The third element is Sulphur.

For PSL1 pipe, Maximum Sulphur is 0.03%. For PSL2 pipes maximum Sulphur is 0.02%.

## Mechanical properties

Standard	Grade	Tensile Strength (MPa)	Yield Strength (MPa)	Trans.Elongation (%)	Impact Test (J)
ASTM A106	B	>415	≥240	≥16.5	–
ASTM A53	B	>415	≥240	–	–
API 5L	B(PSL1)	>414	≥241	As clause a	–

A53 is usually for defining welded pipe, while A106 for seamless. If you ask for A53, suppliers will also quote A106 or API 5L as an alternative.

PARAMETER	PSL1	PSL2
Yield strength, maximum	None	Maximum for each grade
UTS (Ultimate Tensile Strength) maximum	None	Maximum for each grade
Fracture toughness	None required	Required for all grades

For PSL2 pipe there is a limit on Maximum Yield & Ultimate Tensile Strength whereas for PSL1 pipe meeting the minimum requirements are sufficient. The second requirement that is mandatory for PSL2 pipe is Fracture toughness which is not required for the PSL1 pipe.

### ASME B36.10 Tolerances:

#### Outside Diameter:

1/8" a 1-1/2" ±0.4 mm

1-1/2" a 4" ±0.8 mm

4" a 8" +1.6 mm -0.8 mm

8" a 18" +2.4 mm -0.8 mm

#### Wall Thickness:

-12.5% of the nominal size

## Size Table — Carbon Steel Pipe

Nominal Diameter	Outside Diameter		Nominal Wall Thickness (In)														
	Inch.	mm	-	5S	5	10S	10	20	30	STD	40	60	XS	80	120	160	XXS
1/8"	0.405	10.29	WT(In)		0.035	0.049	0.049			0.068	0.068		0.095	0.095			
			Kg/Meter		0.21	0.28	0.28			0.36	0.36		0.47	0.47			
1/4"	0.540	13.72	WT(In)		0.049	0.065	0.065			0.088	0.088		0.119	0.119			
			Kg/Meter		0.38	0.49	0.49			0.63	0.63		0.80	0.80			
3/8"	0.675	17.15	WT(In)		0.049	0.065	0.065			0.091	0.091		0.126	0.126			
			Kg/Meter		0.49	0.63	0.63			0.84	0.84		1.10	1.10			
1/2"	0.840	21.34	WT(In)	0.065	0.065	0.083	0.083			0.109	0.109		0.147	0.147		0.188	0.294
			Kg/Meter	0.80	0.80	1.00	1.00			1.27	1.27		1.62	1.62		1.95	2.55
3/4"	1.050	26.67	WT(In)	0.065	0.065	0.083	0.083			0.113	0.113		0.154	0.154		0.219	0.308
			Kg/Meter	1.02	1.02	1.28	1.28			1.68	1.68		2.19	2.19		2.89	3.63
1"	1.315	33.40	WT(In)	0.065	0.065	0.109	0.109			0.133	0.133		0.179	0.179		0.250	0.358
			Kg/Meter	1.29	1.29	2.09	2.09			2.50	2.50		3.23	3.23		4.23	5.45
1-1/4"	1.660	42.16	WT(In)	0.065	0.065	0.109	0.109			0.140	0.140		0.191	0.191		0.250	0.382
			Kg/Meter	1.65	1.65	2.69	2.69			3.38	3.38		4.46	4.46		5.60	7.76
1-1/2"	1.900	48.26	WT(In)	0.065	0.065	0.109	0.109			0.145	0.145		0.200	0.200		0.281	0.400
			Kg/Meter	1.90	1.90	3.10	3.10			4.05	4.05		5.41	5.41		7.23	9.54
2"	2.375	60.33	WT(In)	0.065		0.109	0.109			0.154	0.154		0.218	0.218		0.344	0.436
			Kg/Meter	2.39		3.93	3.93			5.44	5.44		7.48	7.48		11.11	13.44
2-1/2"	2.875	73.03	WT(In)	0.083	0.083	0.120	0.120			0.203	0.203		0.276	0.276		0.375	0.552
			Kg/Meter	3.68	3.68	5.26	5.26			8.62	8.62		11.41	11.41		14.91	20.39
3"	3.500	88.90	WT(In)	0.083	0.083	0.120	0.120			0.216	0.216		0.300	0.300		0.438	0.600
			Kg/Meter	4.51	4.51	6.45	6.45			11.28	11.28		15.26	15.26		21.32	27.67
3-1/2"	4.000	101.60	WT(In)	0.083	0.083	0.120	0.120			0.226	0.226		0.318	0.318			0.636
			Kg/Meter	5.17	5.17	7.40	7.40			13.56	13.56		18.62	18.62			34.02
4"	4.500	114.30	WT(In)	0.083	0.083	0.120	0.120			0.237	0.237	0.281	0.337	0.337	0.438	0.531	0.674
			Kg/Meter	5.83	5.83	8.36	8.36			16.06	16.06	18.85	22.31	22.31	28.29	33.51	41.00
5"	5.563	141.30	WT(In)	0.109	0.109	0.134	0.134	0.203		0.258	0.258		0.375	0.375	0.500	0.625	0.750
			Kg/Meter	9.45	9.45	11.57	11.57	17.30		21.76	21.76		30.93	30.93	40.25	49.07	57.40
6"	6.625	168.28	WT(In)	0.109	0.109	0.134	0.134	0.203		0.280	0.280		0.432	0.432	0.562	0.719	0.864
			Kg/Meter	11.29	11.29	13.83	13.83	20.73		28.25	28.25		42.54	42.54	54.18	67.52	79.14
8"	8.625	219.08	WT(In)	0.109	0.109	0.148	0.148	0.250	0.277	0.322	0.322	0.406	0.500	0.500	0.719	0.906	0.875
			Kg/Meter	14.76	14.76	19.95	19.95	33.29	36.77	42.51	42.51	53.06	64.59	64.59	90.38	111.20	107.82
10"	10.750	273.05	WT(In)	0.134	0.134	0.165	0.165	0.250	0.307	0.365	0.365	0.500	0.500	0.594	0.844	1.125	1.000
			Kg/Meter	22.62	22.62	27.77	27.77	41.74	50.98	60.27	60.27	81.49	81.49	95.98	132.93	172.17	155.03
12"	12.750	323.85	WT(In)	0.156	0.165	0.180	0.180	0.250	0.330	0.375	0.406	0.562	0.500	0.688	1.000	1.312	1.000
			Kg/Meter	31.24	33.02	35.98	35.98	49.69	65.17	73.79	79.69	108.91	97.39	131.95	186.83	238.61	186.83
14"	14.000	355.60	WT(In)	0.156		0.188	0.250	0.312	0.375	0.375	0.438	0.594	0.500	0.750	1.094	1.406	
			Kg/Meter	34.34		41.29	54.66	67.90	81.24	81.24	94.45	126.61	107.33	158.01	224.49	281.54	

Nominal Diameter	Outside Diameter		Nominal Wall Thickness (In)														
	Inch.	mm	-	5S	5	10S	10	20	30	STD	40	60	XS	80	120	160	XXS
16"	16.000	406.40	WT(In)	0.165		0.188	0.250	0.312	0.375	0.375	0.500	0.656	0.500	0.844	1.219	1.594	
			Kg/Meter	41.54		47.27	62.61	77.83	93.16	93.16	123.23	160.04	123.23	203.39	286.49	365.11	
18"	18.000	457.20	WT(In)	0.165		0.188	0.250	0.312	0.438	0.375	0.562	0.750	0.500	0.938	1.375	1.781	
			Kg/Meter	46.79		53.24	70.56	87.75	122.31	105.09	155.82	205.71	139.13	254.47	363.46	459.29	
20"	20.000	508.00	WT(In)	0.188		0.219	0.250	0.375	0.500	0.375	0.594	0.812	0.500	1.031	1.500	1.969	
			Kg/Meter	59.22		68.88	78.51	117.01	155.03	117.01	183.28	247.73	155.03	310.96	441.23	564.50	
24"	24.000	609.60	WT(In)	0.219		0.250	0.250	0.375	0.562	0.375	0.688	0.969	0.500	1.219	1.812	2.344	
			Kg/Meter	82.81		94.41	94.41	140.86	209.44	140.86	255.01	354.84	186.83	441.54	639.25	807.11	
30"	30.000	762.00	WT(In)	0.250		0.312	0.312	0.500	0.625	0.375			0.500				
			Kg/Meter	118.26		147.28	147.28	234.53	291.91	176.64			234.53				
36"	36.000	914.40	WT(In)				0.312	0.500	0.625	0.375	0.750		0.500				
			Kg/Meter				177.04	282.23	351.54	212.41	420.36		282.23				
42"	42.000	1,066.80	WT(In)						0.375			0.500					
			Kg/Meter						248.19			329.93					

# Pressure and Temperature Table — Carbon Steel Pipe

Nominal Diameter	Outside Diameter	Wall Thickness	Pipe Schedule	Temperature (°F)								
				100	200	300	400	500	600	650	700	750
	Allowable Stress (psi)											
	Inch.	16700	16700	16700	15500	14400	13500	13200	12900	12600		
1/8"	0.405	0.049	10S-10	4041	4041	4041	3751	3484	3267	3194	3121	3049
		0.068	STD-40	5608	5608	5608	5205	4836	4533	4433	4332	4231
		0.095	XS-80	7835	7835	7835	7272	6756	6333	6193	6052	5911
1/4"	0.540	0.065	10S-10	4020	4020	4020	3731	3467	3250	3178	3106	3033
		0.088	STD-40	5443	5443	5443	5052	4693	4400	4302	4204	4107
		0.119	XS-80	7360	7360	7360	6831	6347	5950	5818	5686	5553
3/8"	0.675	0.065	10S-10	3216	3216	3216	2985	2773	2600	2542	2484	2427
		0.091	STD-40	4503	4503	4503	4179	3883	3640	3559	3478	3397
		0.126	XS-80	6235	6235	6235	5787	5376	5040	4928	4816	4704
1/2"	0.840	0.083	10S-10	3300	3300	3300	3063	2846	2668	2609	2549	2490
		0.109	STD-40	4334	4334	4334	4023	3737	3504	3426	3348	3270
		0.147	XS-80	5845	5845	5845	5425	5040	4725	4620	4515	4410
3/4"	1.050	0.083	10S-10	2640	2640	2640	2450	2277	2134	2087	2039	1992
		0.113	STD-40	3594	3594	3594	3336	3099	2906	2841	2777	2712
		0.154	XS-80	4899	4899	4899	4547	4224	3960	3872	3784	3696
1"	1.315	0.109	10S-10	2769	2769	2769	2570	2387	2238	2188	2139	2089
		0.133	STD-40	3378	3378	3378	3135	2913	2731	2670	2609	2549
		0.179	XS-80	4546	4546	4546	4220	3920	3675	3594	3512	3430
1-1/4"	1.660	0.109	10S-10	2193	2193	2193	2036	1891	1773	1733	1694	1655
		0.140	STD-40	2817	2817	2817	2614	2429	2277	2227	2176	2125
		0.191	XS-80	3843	3843	3843	3567	3314	3107	3038	2969	2900
1-1/2"	1.900	0.109	10S-10	1916	1916	1916	1778	1652	1549	1515	1480	1446
		0.145	STD-40	2549	2549	2549	2366	2198	2061	2015	1969	1923
		0.200	XS-80	3516	3516	3516	3263	3032	2842	2779	2716	2653
2"	2.375	0.109	10S-10	1533	1533	1533	1423	1322	1239	1212	1184	1157
		0.154	STD-40	2166	2166	2166	2010	1867	1751	1712	1673	1634
		0.219	XS-80	3080	3080	3080	2859	2656	2490	2434	2379	2324
2-1/2"	2.875	0.120	10S-10	1394	1394	1394	1294	1202	1127	1102	1077	1052
		0.203	STD-40	2358	2358	2358	2189	2034	1906	1864	1822	1779
		0.276	XS-80	3206	3206	3206	2976	2765	2592	2534	2477	2419
3"	3.500	0.120	10S-10	1145	1145	1145	1063	987	926	905	885	864
		0.216	STD-40	2061	2061	2061	1913	1777	1666	1629	1592	1555
		0.300	XS-80	2863	2863	2863	2657	2469	2314	2263	2211	2160
3-1/2"	4.000	0.120	10S-10	1002	1002	1002	930	864	810	792	774	756
		0.226	STD-40	1887	1887	1887	1752	1627	1526	1492	1458	1424
		0.318	XS-80	2655	2655	2655	2465	2290	2147	2099	2051	2003

Nominal Diameter	Outside Diameter	Wall Thickness	Pipe Schedule	Temperature (°F)														
				100	200	300	400	500	600	650	700	750						
	Allowable Stress (psi)									16700	16700	16700	15500	14400	13500	13200	12900	12600
	Inch.		16700	16700	16700	15500	14400	13500	13200	12900	12600							
4"	4.500	0.120	10S-10	891	891	891	827	768	720	704	688	672						
		0.237	STD-40	1759	1759	1759	1633	1517	1422	1390	1359	1327						
		0.337	XS-80	2501	2501	2501	2322	2157	2022	1977	1932	1887						
5"	5.563	0.134	10S-10	805	805	805	747	694	650	636	621	607						
		0.258	STD-40	1549	1549	1549	1438	1336	1252	1224	1197	1169						
		0.375	XS-80	2251	2251	2251	2090	1941	1820	1780	1739	1699						
6"	6.625	0.134	10S-10	676	676	676	627	583	546	534	522	510						
		0.280	STD-40	1412	1412	1412	1310	1217	1141	1116	1090	1065						
		0.432	XS-80	2178	2178	2178	2021	1878	1761	1721	1682	1643						
8"	8.625	0.148	10S-10	573	573	573	532	494	463	453	443	432						
		0.322	STD-40	1247	1247	1247	1157	1075	1008	986	963	941						
		0.500	XS-80	1936	1936	1936	1797	1670	1565	1530	1496	1461						
10"	10.750	0.165	10S-10	513	513	513	476	442	414	405	396	387						
		0.365	STD-40	1134	1134	1134	1053	978	917	896	876	856						
		0.500	XS-80	1553	1553	1553	1442	1340	1256	1228	1200	1172						
12"	12.750	0.180	10S-10	472	472	472	438	407	381	373	364	356						
		0.375	STD-40	982	982	982	912	847	794	776	759	741						
		0.500	XS-80	1310	1310	1310	1216	1129	1059	1035	1012	988						
14"	14.000	0.188	10S	449	449	449	416	387	363	355	346	338						
		0.250	10	596	596	596	554	514	482	471	461	450						
		0.375	STD	895	895	895	830	771	723	707	691	675						
		0.500	XS	1193	1193	1193	1107	1029	964	943	921	900						
16"	16.000	0.188	10S	392	392	392	364	338	317	310	303	296						
		0.250	10	522	522	522	484	450	422	413	403	394						
		0.375	STD	783	783	783	727	675	633	619	605	591						
		0.500	XS	1044	1044	1044	969	900	844	825	806	788						
18"	18.000	0.188	10S	349	349	349	324	301	282	276	269	263						
		0.250	10	464	464	464	431	400	375	367	358	350						
		0.375	STD	696	696	696	646	600	563	550	538	525						
		0.500	XS	928	928	928	861	800	750	733	717	700						
20"	20.000	0.219	10S	366	366	366	339	315	296	289	283	276						
		0.250	10	418	418	418	388	360	338	330	323	315						
		0.375	STD	626	626	626	581	540	506	495	484	473						
		0.500	XS	835	835	835	775	720	675	660	645	630						
24"	24.000	0.250	10-10S	348	348	348	323	300	281	275	269	263						
		0.375	STD	522	522	522	484	450	422	413	403	394						
		0.500	XS	696	696	696	646	600	563	550	538	525						

Allowable stress is calculated with Barlow's Formula mentioned in the last page of this data sheet.

## Conversion Tables

Weight Conversion Table					
	Kilogram	Ton	Ounce	Pound	Slug
Kilogram	1	0.001	35.27	2.2	0.0685
Ton	1000	1	35274	2204.62	68.58
Ounce	0.028349	0.000028	1	0.0625	0.00194
Pound	0.45359	0.000454	16	1	0.03111
Slug	14.59	0.01459	514.82	32.136	1

Length Conversion Table					
	Meter	Kilometer	Inch	Foot	Mile
Meter	1	0.001	39.37	3.28084	0.000621
Kilometer	1000	1	39370.1	3280.84	0.62137
Inch	0.0254	0.0000254	1	0.08333	0.000015
Foot	0.3048	0.000348	12	1	0.000189
Mile	1609.34	1.609	63.346	5280	1

## Formulas

Linear weight formula for smooth end pipe	
P Carbon Steel	$(D - e) * e * 0.02466$

*The coefficient depends on the weight of the material.*

**Where:**

<b>P</b>	Weight [Kg/m]
<b>D</b>	Exterior Diameter [mm]
<b>e</b>	Wall Thickness [mm]

Hydrostatic Formula (Barlow's Formula)	
<b>P</b>	$(2St)/D$
<b>S</b>	$(P*D)/2t$

Where:

<b>P</b>	Hydrostatic test pressure in Psi [MPa]
<b>D</b>	Outside diameter corresponding to specified ANSI pipe size, or outside diameter calculated by adding 2t to the specified inside diameter, inch [mm].
<b>t</b>	Wall Thickness according to specified ANSI schedule number, or 1.143 times the specified minimum wall thickness, inch [mm].
<b>S</b>	Permissible Stress = Yield strength (Ys) in Psi [MPa] 60%

Conventional Terms	
<b>API</b>	American Petroleum Institute
<b>ANSI</b>	American National Standards Institute
<b>ASME</b>	American Society of Mechanical Engineers
<b>ASTM</b>	American Society of Testing Materials
<b>NACE</b>	National Association of Corrosion Engineers
<b>AWWA</b>	American Water Works Association
<b>SSAW</b>	Spiral / helical Seam Submerged Arc Welded pipe
<b>DSAW</b>	Double seam Submerged Arc Welded pipe
<b>LSAW</b>	Longitudinal seam Submerged Arc Welded pipe (one seam)
<b>ERW-HFI</b>	Electric Resistance Welded High Frequency Induced
<b>EFW</b>	Electric Fusion Welded Tube
<b>SRL</b>	Single Random Lengths: minimum average Lengths 17'6" - shortest length permissible is 9".
<b>DRL</b>	Double Random Lengths: minimum average Lengths 35" - shortest length permissible is 14".

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