Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5) (7)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi	Min. Yield Strength, ksi	Max. Temp., °F	
	Stainless Steel — Pipes and Tubes (3)													
1	18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	>3/8 thk.	8	(28)	−425	70	25	1,500	
2	18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	>3/8 thk.	8	(28) (36)	−425	70	25	1,500	
3	18Cr–8Ni	Tube	A213	TP304L	S30403	...	...	8	(14) (36)	−425	70	25	1,500	
4	18Cr–8Ni	Tube	A269	TP304L	S30403	...	...	8	(14) (36)	−425	70	25	1,500	
5	18Cr–8Ni	Tube	A270	TP304L	S30403	...	...	8	(14)	−425	70	25	1,500	
6	18Cr–8Ni	Pipe	A312	TP304L	S30403	...	...	8	...	−425	70	25	1,500	
304L 7	18Cr–8Ni	Pipe	A358	304L	S30403	...	...	8	(36)	−425	70	25	1,500	Next Page-Line 7
8	16Cr–12Ni–2Mo	Tube	A213	TP316L	S31603	...	...	8	(14) (36)	−425	70	25	1,500	
9	16Cr–12Ni–2Mo	Tube	A269	TP316L	S31603	...	...	8	(14) (36)	−425	70	25	1,500	
10	16Cr–12Ni–2Mo	Tube	A270	TP316L	S31603	...	...	8	(14)	−425	70	25	1,500	
11	16Cr–12Ni–2Mo	Pipe	A312	TP316L	S31603	...	...	8	...	−425	70	25	1,500	
316L 12	16Cr–12Ni–2Mo	Pipe	A358	316L	S31603	...	...	8	(36)	−425	70	25	1,500	Next Page-Line 12
13	16Cr–12Ni–2Mo–Ti	Tube	A213	TP316Ti	S31635	...	...	8	(30)	−325	75	30	1,500	
14	18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	>3/8 thk.	8	(28) (30)	−425	70	25	1,500	
15	18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	>3/8 thk.	8	(28) (30) (36)	−425	70	25	1,500	
16	18Cr–10Ni–Ti	Smls. pipe	A312	TP321H	S32109	...	>3/8 thk.	8	(30)	−325	70	25	1,500	
17	18Cr–10Ni–Ti	Smls. pipe	A376	TP321H	S32109	...	>3/8 thk.	8	(30) (36)	−325	70	25	1,500	
18	25Cr–12Ni	...	A451	CPH8	J93400	...	...	8	(26) (28) (35)	−325	65	28	1,500	
19	25Cr–20Ni	...	A451	CPK20	J94202	...	...	8	(12) (28) (35) (39)	−325	65	28	1,500	
20	11Cr–Ti	Tube	A268	TP409	S40900	...	...	7	(35)	−20	60	30	100	
21	18Cr–Ti	Tube	A268	TP430Ti	S43036	...	...	7	(35) (49)	−20	60	40	100	
22	16Cr–14Ni–2Mo	...	A451	CPF10MC	J92971	...	...	8	(28)	−325	70	30	100	
23	12Cr–Al	Tube	A268	TP405	S40500	...	...	7	(35)	−20	60	30	1,000	
24	13Cr	Tube	A268	TP410	S41000	...	...	6	(35)	−20	60	30	1,200	
25	17Cr	Tube	A268	TP430	S43000	...	...	7	(35) (49)	−20	60	35	1,200	
26	18Cr–13Ni–3Mo	Pipe	A312	TP317L	S31703	...	...	8	...	−325	75	30	850	
27	25Cr–20Ni	Pipe	A312	TP310S	S31008	...	...	8	(28) (35)	−325	75	30	1,500	
28	25Cr–20Ni	...	A358	310S	S31008	...	...	8	(28) (35) (36)	−325	75	30	1,500	
29	25Cr–20Ni	Pipe	A409	TP310S	S31008	...	...	8	(28) (31) (35) (36)	−325	75	30	1,500	
30	18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	≤3/8 thk.	8	(28)	−425	75	30	1,500	
31	18Cr–10Ni–Ti	Wld. pipe	A312	TP321	S32100	...	...	8	(28)	−425	75	30	1,500	
32	18Cr–10Ni–Ti	Wld. pipe	A358	321	S32100	...	...	8	(28) (36)	−425	75	30	1,500	
33	18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	≤3/8 thk.	8	(28) (36)	−425	75	30	1,500	
34	18Cr–10Ni–Ti	Wld. pipe	A409	TP321	S32100	...	...	8	(28) (36)	−425	75	30	1,500	
35	23Cr–12Ni	Pipe	A312	TP309	...	...	...	8	(28) (35) (39)	−325	75	30	1,500	
36	23Cr–12Ni	...	A358	309S	S30908	...	...	8	(28) (31) (35) (36)	−325	75	30	1,500	

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Min. Temp. to 100	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]																							
		200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	1,250	1,300	1,350	1,400	1,450	1,500
		Stainless Steel — Pipes and Tubes (3)																						
1	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
2	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
3	16.7	*16.7*	*16.7*	**15.8**	**14.7**	**14.0**	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*12.6*	*12.3*	12.0	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9
4	16.7	*16.7*	*16.7*	**15.8**	**14.7**	**14.0**	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*12.6*	*12.3*	12.0	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9
5	16.7	*16.7*	*16.7*	**15.8**	**14.7**	**14.0**	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*12.6*	*12.3*	12.0	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9
6	16.7	*16.7*	*16.7*	**15.8**	**14.7**	**14.0**	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*12.6*	*12.3*	12.0	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9
304L 7	16.7	*16.7*	*16.7*	**15.8**	**14.7**	**14.0**	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*12.6*	*12.3*	12.0	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9
8	16.7	*16.7*	*16.7*	**15.7**	**14.8**	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**11.6**	*11.4*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0
9	16.7	*16.7*	*16.7*	**15.7**	**14.8**	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**11.6**	*11.4*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0
10	16.7	*16.7*	*16.7*	**15.7**	**14.8**	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**11.6**	*11.4*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0
11	16.7	*16.7*	*16.7*	**15.7**	**14.8**	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**11.6**	*11.4*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0
316L 12	16.7	*16.7*	*16.7*	**15.7**	**14.8**	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**11.6**	*11.4*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0
13	20.0	*20.0*	*20.0*	**19.3**	**17.8**	**16.8**	**16.5**	**16.2**	**16.1**	**15.9**	**15.8**	**15.7**	**15.5**	**15.3**	**15.1**	12.3	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
14	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
15	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
16	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
17	16.7	*16.7*	*16.7*	*16.7*	**16.1**	**15.2**	**14.9**	**14.6**	**14.3**	**14.1**	**13.9**	**13.8**	**13.6**	**13.5**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
18	18.7	*18.7*	*18.5*	*18.0*	*17.7*	**17.1**	**16.7**	**16.3**	**15.9**	**15.4**	*14.9*	*14.4*	*13.9*	11.1	8.5	6.5	5.0	3.8	2.9	2.3	1.8	1.3	0.9	0.8
19	18.7	*18.7*	*18.5*	*18.0*	*17.7*	**17.1**	**16.7**	**16.3**	**15.9**	**15.4**	*14.9*	*14.4*	*13.9*	11.3	9.8	8.5	7.3	6.0	4.8	3.5	2.4	1.6	1.1	0.8
20	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	20.0	20.0	19.6	19.3	19.0	18.5	18.1	17.7	17.1	16.4	15.6	14.3	8.4	4.0	...	...	...	...	...	...	...	...	...	...
24	20.0	20.0	19.6	19.3	19.0	18.5	18.1	17.7	17.1	16.4	15.6	12.3	8.8	6.4	4.4	2.9	1.8	1.0	...	...	...	...	...	...
25	20.0	20.0	19.6	19.3	19.0	18.5	18.1	17.7	17.1	16.4	15.6	12.0	9.2	6.5	4.5	3.2	2.4	1.8	...	...	...	...	...	...
26	20.0	*20.0*	*20.0*	**18.9**	**17.7**	**16.9**	**16.5**	**16.2**	**15.8**	**15.5**	**15.2**	...	...	...	...	...	...	...	...	...	...	...	...	...
27	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.5**	**18.2**	**17.9**	**17.7**	**17.4**	*17.2*	*16.9*	*15.9*	9.9	7.1	5.0	3.6	2.5	1.5	0.8	0.5	0.4	0.3	0.2
28	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.5**	**18.2**	**17.9**	**17.7**	**17.4**	*17.2*	*16.9*	*15.9*	9.9	7.1	5.0	3.6	2.5	1.5	0.8	0.5	0.4	0.3	0.2
29	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.5**	**18.2**	**17.9**	**17.7**	**17.4**	*17.2*	*16.9*	*15.9*	9.9	7.1	5.0	3.6	2.5	1.5	0.8	0.5	0.4	0.3	0.2
30	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
31	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
32	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
33	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
34	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	9.6	6.9	5.0	3.6	2.6	1.7	1.1	0.8	0.5	0.3
35	20.0	*20.0*	*20.0*	*20.0*	*19.4*	**18.8**	**18.5**	**18.2**	**18.0**	**17.7**	*17.5*	*17.2*	*16.9*	13.8	10.3	7.6	5.5	4.0	3.0	2.2	1.7	1.3	1.0	0.8
36	20.0	*20.0*	*20.0*	*20.0*	*19.4*	**18.8**	**18.5**	**18.2**	**18.0**	**17.7**	*17.5*	*17.2*	*16.9*	13.8	10.3	7.6	5.5	4.0	3.0	2.2	1.7	1.3	1.0	0.8

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5) (7)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi	Min. Yield Strength, ksi	Max. Temp., °F
	Stainless Steel — Pipes and Tubes (3)												
37	18Cr–8Ni	...	A451	CPF8	J92600	...	...	8	(26) (28)	−425	70	30	1,500
38	18Cr–10Ni–Cb	Pipe	A312	TP347	S34700	...	...	8	...	−425	75	30	1,500
39	18Cr–10Ni–Cb	Pipe	A358	347	S34700	...	...	8	(30) (36)	−425	75	30	1,500
40	18Cr–10Ni–Cb	Pipe	A376	TP347	S34700	...	...	8	(30) (36)	−425	75	30	1,500
41	18Cr–10Ni–Cb	Pipe	A409	TP347	S34700	...	...	8	(30) (36)	−425	75	30	1,500
42	18Cr–10Ni–Cb	Pipe	A312	TP348	S34800	...	...	8	...	−325	75	30	1,500
43	18Cr–10Ni–Cb	Pipe	A358	348	S34800	...	...	8	(30) (36)	−325	75	30	1,500
44	18Cr–10Ni–Cb	Pipe	A376	TP348	S34800	...	...	8	(30) (36)	−325	75	30	1,500
45	18Cr–10Ni–Cb	Pipe	A409	TP348	S34800	...	...	8	(30) (36)	−325	75	30	1,500
46	25Cr–12Ni	...	A451	CPH10	J93402	...	...	8	(12) (14) (28) (35) (39)	−325	70	30	1,500
47	25Cr–12Ni	...	A451	CPH20	J93402	...	...	8	(12) (14) (28) (35) (39)	−325	70	30	1,500
48	25Cr–20Ni	Pipe	A312	TP310H	S31009	...	...	8	(29) (35) (39)	−325	75	30	1,500
49	18Cr–10Ni–Cb	...	A451	CPF8C	J92710	...	...	8	(28)	−325	70	30	1,500
50	18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	≤3/8 thk.	8	(28) (30)	−425	75	30	1,500
51	18Cr–10Ni–Ti	Wld. pipe	A312	TP321	S32100	...	...	8	(28) (30)	−425	75	30	1,500
52	18Cr–10Ni–Ti	Wld. pipe	A358	321	S32100	...	...	8	(28) (30) (36)	−425	75	30	1,500
53	18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	≤3/8 thk.	8	(28) (30) (36)	−425	75	30	1,500
54	18Cr–10Ni–Ti	Wld. pipe	A409	TP321	S32100	...	...	8	(28) (30) (36)	−425	75	30	1,500
55	18Cr–10Ni–Ti	Smls. pipe	A312	TP321H	S32109	...	≤3/8 thk.	8	(30)	−325	75	30	1,500
56	18Cr–10Ni–Ti	Wld. pipe	A312	TP321H	S32109	...	...	8	(30)	−325	75	30	1,500
57	18Cr–10Ni–Ti	Wld. pipe	A358	321H	S32109	...	...	8	(30) (36)	−325	75	30	1,500
58	18Cr–10Ni–Ti	Smls. pipe	A376	TP321H	S32109	...	≤3/8 thk.	8	(30) (36)	−325	75	30	1,500
59	16Cr–12Ni–2Mo	Tube	A213	TP316	S31600	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	1,500
60	16Cr–12Ni–2Mo	Tube	A269	TP316	S31600	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	1,500
61	16Cr–12Ni–2Mo	Tube	A270	TP316	S31600	...	...	8	(14) (26) (28)	−425	75	30	1,500
62	16Cr–12Ni–2Mo	Pipe	A312	TP316	S31600	...	...	8	(26) (28)	−425	75	30	1,500
316 63	16Cr–12Ni–2Mo	Pipe	A358	316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	1,500
64	16Cr–12Ni–2Mo	Pipe	A376	TP316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	1,500
65	16Cr–12Ni–2Mo	Pipe	A409	TP316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	1,500
66	18Cr–13Ni–3Mo	Pipe	A312	TP317	S31700	...	...	8	(26) (28)	−325	75	30	1,500
67	18Cr–13Ni–3Mo	Pipe	A409	TP317	S31700	...	...	8	(26) (28) (31) (36)	−325	75	30	1,500

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Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Min. Temp. to 100	200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	1,250	1,300	1,350	1,400	1,450	1,500
	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]																							
	Stainless Steel — Pipes and Tubes (3) (Cont'd)																							
37	20.0	*20.0*	*20.0*	**18.6**	**17.5**	**16.6**	**16.2**	**15.8**	**15.5**	**15.2**	*14.9*	*14.6*	*14.3*	*12.2*	9.5	7.5	6.0	4.8	3.9	3.3	2.7	2.3	2.0	1.7
38	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
39	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
40	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
41	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
42	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
43	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
44	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
45	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.3**	**19.0**	**18.7**	**18.5**	**18.3**	*18.2*	*18.1*	*18.1*	*16.0*	*12.1*	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
46	20.0	*20.0*	*19.9*	*19.4*	*18.9*	**18.3**	**17.9**	**17.5**	**17.0**	**16.5**	*16.0*	*15.4*	*14.9*	11.1	8.5	6.5	5.0	3.8	2.9	2.3	1.8	1.3	0.9	0.8
47	20.0	*20.0*	*19.9*	*19.4*	*18.9*	**18.3**	**17.9**	**17.5**	**17.0**	**16.5**	*16.0*	*15.4*	*14.9*	11.1	8.5	6.5	5.0	3.8	2.9	2.3	1.8	1.3	0.9	0.8
48	20.0	*20.0*	*20.0*	*20.0*	*19.3*	**18.5**	**18.2**	**17.9**	**17.7**	**17.4**	*17.2*	*16.9*	*16.7*	13.8	10.3	7.6	5.5	4.0	3.0	2.2	1.7	1.3	1.0	0.8
49	20.0	*20.0*	*20.0*	*18.6*	**17.5**	**16.6**	**16.2**	**15.8**	**15.5**	**15.2**	*14.9*	*14.6*	*14.3*	*14.0*	*12.1*	*9.1*	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8
50	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
51	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
52	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
53	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
54	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
55	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
56	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
57	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
58	20.0	*20.0*	*20.0*	*20.0*	**19.3**	**18.3**	**17.8**	**17.5**	**17.2**	**16.9**	**16.7**	**16.5**	**16.4**	**16.2**	12.3	9.1	6.9	5.4	4.1	3.2	2.5	1.9	1.5	1.1
59	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	*9.8*	7.4	5.5	4.1	3.1	2.3	1.7	1.3
60	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
61	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
62	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
316 63	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
64	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
65	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
66	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
67	20.0	*20.0*	*20.0*	**19.3**	**18.0**	**17.0**	**16.6**	**16.3**	**16.1**	**15.9**	**15.7**	**15.6**	**15.4**	**15.3**	*15.1*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5) (7)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi	Min. Yield Strength, ksi	Max. Temp., °F
	Stainless Steel — Pipes and Tubes (3)												
68	16Cr–12Ni–2Mo	Pipe	A376	TP316H	S31609	...	...	8	(26) (31) (36)	−325	75	30	1,500
69	16Cr–12Ni–2Mo	Pipe	A312	TP316H	S31609	...	...	8	(26)	−325	75	30	1,500
70	18Cr–10Ni–Cb	Pipe	A376	TP347H	S34709	...	...	8	(30) (36)	−325	75	30	1,500
71	18Cr–10Ni–Cb	Pipe	A312	TP347	S34700	...	...	8	(28)	−425	75	30	1,500
72	18Cr–10Ni–Cb	Pipe	A358	347	S34700	...	...	8	(28) (30) (36)	−425	75	30	1,500
73	18Cr–10Ni–Cb	Pipe	A376	TP347	S34700	...	...	8	(28) (30) (36)	−425	75	30	1,500
74	18Cr–10Ni–Cb	Pipe	A409	TP347	S34700	...	...	8	(28) (30) (36)	−425	75	30	1,500
75	18Cr–10Ni–Cb	Pipe	A312	TP348	S34800	...	...	8	(28)	−325	75	30	1,500
76	18Cr–10Ni–Cb	Pipe	A358	348	S34800	...	...	8	(28) (30) (36)	−325	75	30	1,500
77	18Cr–10Ni–Cb	Pipe	A376	TP348	S34800	...	...	8	(28) (30) (36)	−325	75	30	1,500
78	18Cr–10Ni–Cb	Pipe	A409	TP348	S34800	...	...	8	(28) (30) (36)	−325	75	30	1,500
79	18Cr–10Ni–Cb	Pipe	A312	TP347H	S34709	...	...	8	...	−325	75	30	1,500
80	18Cr–10Ni–Cb	Pipe	A312	TP348H	S34809	...	...	8	...	−325	75	30	1,500
81	18Cr–8Ni	Tube	A213	TP304	S30400	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	1,500
82	18Cr–8Ni	Tube	A269	TP304	S30400	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	1,500
83	18Cr–8Ni	Tube	A270	TP304	S30400	...	...	8	(14) (26) (28)	−425	75	30	1,500
84	18Cr–8Ni	Pipe	A312	TP304	S30400	...	...	8	(26) (28)	−425	75	30	1,500
304 85	18Cr–8Ni	Pipe	A358	304	S30400	...	...	8	(26) (28) (31) (36)	−425	75	30	1,500
86	18Cr–8Ni	Pipe	A376	TP304	S30400	...	...	8	(20) (26) (28) (31) (36)	−425	75	30	1,500
87	18Cr–8Ni	Pipe	A376	TP304H	S30409	...	...	8	(26) (31) (36)	−325	75	30	1,500
88	18Cr–8Ni	Pipe	A409	TP304	S30400	...	...	8	(26) (28) (31) (36)	−425	75	30	1,500
89	18Cr–8Ni	Pipe	A312	TP304H	S30409	...	...	8	(26)	−325	75	30	1,500
90	18Cr–12Ni–2Mo	...	A451	CPF8M	J92900	...	...	8	(26) (28)	−425	70	30	1,500
91	44Fe–25Ni–21Cr–Mo	Tube	A249	...	N08904	...	...	45	...	−325	71	31	500
92	44Fe–25Ni–21Cr–Mo	Pipe	A312	...	N08904	...	...	45	...	−325	71	31	500
93	20Cr–Cu	Tube	A268	TP443	S44300	...	...	a	(35)	−20	70	40	1,000
94	27Cr	Tube	A268	TP446-1	S44600	...	...	10I	(35)	−20	70	40	1,000
95	12Cr	Wld. pipe	A1053	50	S41003	...	...	7	...	−20	70	50	600
96	25Cr–8Ni–N	...	A451	CPE20N	J92802	...	...	8	(35) (39)	−325	80	40	900
97	23Cr–4Ni–Mo–Cu–N	...	A789	...	S32304	...	...	10H	(25)	−60	87	58	600
98	23Cr–4Ni–Mo–Cu–N	...	A790	...	S32304	...	...	10H	(25)	−60	87	58	600
99	23Cr–4Ni–Mo–Cu–N	Wld. pipe	A928	2304	S32304	...	...	10H	(25)	−60	87	58	600

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Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]

Stainless Steel — Pipes and Tubes (3) (Cont'd)

Line No.	Min. Temp. to 100	200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	1,250	1,300	1,350	1,400	1,450	1,500
68	20.0	20.0	20.0	19.3	18.0	17.0	16.6	16.3	16.1	15.9	15.7	15.6	15.4	15.3	15.1	12.4	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
69	20.0	20.0	20.0	19.3	18.0	17.0	16.6	16.3	16.1	15.9	15.7	15.6	15.4	15.3	15.1	12.4	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3
70	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
71	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
72	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
73	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
74	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
75	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
76	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
77	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
78	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
79	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
80	20.0	20.0	20.0	20.0	20.0	19.3	19.0	18.7	18.5	18.3	18.2	18.1	18.1	18.1	17.4	14.1	10.5	7.9	5.9	4.4	3.2	2.5	1.8	1.3
81	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
82	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
83	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
84	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
304 85	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
86	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
87	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
88	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
89	20.0	20.0	20.0	18.6	17.5	16.6	16.2	15.8	15.5	15.2	14.9	14.6	14.3	14.0	12.4	9.8	7.7	6.1	4.7	3.7	2.9	2.3	1.8	1.4
90	20.0	20.0	18.9	17.0	15.8	15.0	14.7	14.4	14.2	14.1	13.9	13.7	13.4	13.1	11.5	8.9	6.9	5.4	4.3	3.4	2.8	2.3	1.9	1.6
91	20.7	20.7	20.4	18.7	17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
92	20.7	20.7	20.4	18.7	17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
93	23.3	23.3	23.3	23.3	23.3	23.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	...	...	...	...	...	...	...	...	...	...
94	23.3	23.3	22.5	21.9	21.5	20.9	20.6	20.2	19.7	19.1	18.4	17.5	16.4	15.1	...	...	...	...	...	...	...	...	...	...
95	23.3	23.3	23.3	22.8	22.1	21.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
96	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	...	...	...	...	...	...	...	...	...	...	...	...
97	29.0	27.9	26.1	24.7	22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
98	29.0	27.9	26.1	24.7	22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
99	29.0	27.9	26.1	24.7	22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Material	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi
	Carbon Steel — Pipes and Tubes										
A106, Gr C 63	...	...	A106	C	K03501	...	...	1	(57)	B	70
64	A537 Cl. 1	...	A671	CD70	K12437	...	≤2½ thk.	1	(64)	D	70
65	A537 Cl. 1	...	A672	D70	K12437	...	≤2½ thk.	1	(64)	D	70
66	A537 Cl. 1	...	A691	CMSH-70	K12437	...	≤2½ thk.	1	(64)	D	70
67	...	...	A381	Y56	...	...	...	1	(52)	A	71
68	...	...	CSA Z245.1	386	...	...	...	1	(52) (55)	A	71
69	...	...	API 5L	X56	...	PSL 1	...	1	(52) (55) (63)	A	71.1
70	...	...	API 5L	X56	...	PSL 2	...	1	(52) (55) (63)	32	71.1
71	A299 Gr. A	...	A671	CK75	K02803	...	>1 thk.	1	(57) (64)	A	75
72	A299 Gr. A	...	A672	N75	K02803	...	>1 thk.	1	(57) (64)	A	75
73	A299 Gr. A	...	A691	CMS-75	K02803	...	>1 thk.	1	(57) (64)	A	75
74	A299 Gr. A	...	A671	CK75	K02803	...	≤1 thk.	1	(57) (64)	A	75
75	A299 Gr. A	...	A672	N75	K02803	...	≤1 thk.	1	(57) (64)	A	75
76	A299 Gr. A	...	A691	CMS-75	K02803	...	≤1 thk.	1	(57) (64)	A	75
77	...	...	A381	Y60	...	...	...	1	(52)	A	75
78	...	...	CSA Z245.1	414	...	...	...	1	(52) (55)	A	75
79	...	...	API 5L	X60	...	PSL 1	...	1	(52) (55) (63)	A	75.4
80	...	...	API 5L	X60	...	PSL 2	...	1	(52) (55) (63)	32	75.4
81	...	...	CSA Z245.1	448	...	...	...	1	(52) (55)	A	77
82	...	...	API 5L	X65	...	PSL 1	...	1	(52) (55) (63)	A	77.6
83	...	...	API 5L	X65	...	PSL 2	...	1	(52) (55)(63)	32	77.6
84	...	...	CSA Z245.1	483	...	...	...	1	(51) (52) (55)	A	82
85	...	...	API 5L	X70	...	PSL 1	...	1	(51) (52) (55) (63)	A	82.7
86	...	...	API 5L	X70	...	PSL 2	...	1	(51) (52) (55) (63)	32	82.7
87	...	...	CSA Z245.1	550	...	...	...	1	(51) (52) (55)	A	90
88	...	...	API 5L	X80	...	PSL 2	...	1	(51) (52) (55) (63)	32	90.6
	Carbon Steel — Pipes (Structural Grade)										
89	A1011 Gr. 30	...	A134	A1011SS30	K02502	...	...	1	(8a) (8c)	−20	49

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Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Min. Yield Strength, ksi	Max. Temp., °F	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]															
			Min. Temp. to 100	200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100
													Carbon Steel — Pipes and Tubes (Cont'd)					
A106, Gr C 63	40	800	23.3	23.3	23.3	22.8	21.7	20.4	19.8	18.3	14.8	12.0	...	...	...	...	...	...
64	50	700	23.3	23.3	22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...
65	50	700	23.3	23.3	22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...
66	50	700	23.3	23.3	22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...
67	56	400	23.7	23.7	23.7	23.7	...	...	...	...	...	...	...	...	...	...	...	...
68	56	500	23.7	23.7	23.7	23.7	23.7	...	...	...	...	...	...	...	...	...	...	...
69	56.6	500	23.7	23.7	23.7	23.7	23.7	...	...	...	...	...	...	...	...	...	...	...
70	56.6	500	23.7	23.7	23.7	23.7	23.7	...	...	...	...	...	...	...	...	...	...	...
71	40	1,100	25.0	24.4	23.6	22.8	21.7	20.4	19.8	19.1	15.7	12.6	9.3	6.7	4.0	2.5	1.6	1.0
72	40	1,100	25.0	24.4	23.6	22.8	21.7	20.4	19.8	19.1	15.7	12.6	9.3	6.7	4.0	2.5	1.6	1.0
73	40	1,100	25.0	24.4	23.6	22.8	21.7	20.4	19.8	19.1	15.7	12.6	9.3	6.7	4.0	2.5	1.6	1.0
74	42	700	25.0	25.0	24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...
75	42	700	25.0	25.0	24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...
76	42	700	25.0	25.0	24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...
77	60	400	25.0	25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	...
78	60	500	25.0	25.0	25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...
79	60.2	500	25.1	25.1	25.1	25.1	25.1	...	...	...	...	...	...	...	...	...	...	...
80	60.2	500	25.1	25.1	25.1	25.1	25.1	...	...	...	...	...	...	...	...	...	...	...
81	65	500	25.7	25.7	25.7	25.7	25.7	...	...	...	...	...	...	...	...	...	...	...
82	65.3	500	25.9	25.9	25.9	25.9	25.9	...	...	...	...	...	...	...	...	...	...	...
83	65.3	500	25.9	25.9	25.9	25.9	25.9	...	...	...	...	...	...	...	...	...	...	...
84	70	400	27.3	27.3	27.3	27.3	...	...	...	...	...	...	...	...	...	...	...	...
85	70.3	400	27.6	27.6	27.6	27.6	...	...	...	...	...	...	...	...	...	...	...	...
86	70.3	400	27.6	27.6	27.6	27.6	...	...	...	...	...	...	...	...	...	...	...	...
87	80	400	30.0	30.0	30.0	30.0	...	...	...	...	...	...	...	...	...	...	...	...
88	80.5	400	30.2	30.2	30.2	30.2	...	...	...	...	...	...	...	...	...	...	...	...
													Carbon Steel — Pipes (Structural Grade)					
89	30	400	15.0	15.0	15.0	15.0	...	...	...	...	...	...	...	...	...	...	...	...

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Material	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi
	Carbon Steel — Pipes and Tubes										
1	A285 Gr. A	...	A134	A285A	K01700	...	...	1	(8b) (57)	B	45
2	A285 Gr. A	...	A672	A45	K01700	...	...	1	(57) (59) (64)	B	45
3	CW	...	API 5L	A25	...	PSL 1	...	1	(8a) (8c) (63)	−20	45
4	Smls & EW	...	API 5L	A25	...	PSL 1	...	1	(57) (59) (63)	B	45
5	...	...	A179	...	K01200	...	...	1	(57) (59)	−20	47
6	Type F	...	A53	A	K02504	...	...	1	(8a) (8c)	−20	48
7	...	...	A139	A	...	...	...	1	(8b)	A	48
8	...	...	A587	...	K11500	...	...	1	(57) (59)	−20	48
9	...	...	A53	A	K02504	...	...	1	(57) (59)	B	48
10	...	...	A106	A	K02501	...	...	1	(57)	B	48
11	...	...	A135	A	...	...	...	1	(57) (59)	B	48
12	...	...	A369	FPA	K02501	...	...	1	(57)	B	48
13	...	...	API 5L	A	...	PSL 1	...	1	(57) (59) (63)	B	48.6
14	A285 Gr. B	...	A134	A285B	K02200	...	...	1	(8b) (57)	B	50
15	A285 Gr. B	...	A672	A50	K02200	...	...	1	(57) (59) (64)	B	50
16	A285 Gr. C	...	A134	A285C	K02801	...	...	1	(8b) (57)	A	55
17	...	...	A524	II	K02104	...	...	1	(57)	−20	55
18	...	...	A333	1	K03008	...	...	1	(57) (59)	−50	55
19	...	...	A334	1	K03008	...	...	1	(57) (59)	−50	55
20	A285 Gr. C	...	A671	CA55	K02801	...	...	1	(59) (64)	A	55
21	A285 Gr. C	...	A672	A55	K02801	...	...	1	(57) (59) (64)	A	55
22	A516 Gr. 55	...	A672	C55	K01800	...	...	1	(57)(64)	C	55
23	A516 Gr. 60	...	A671	CC60	K02100	...	...	1	(57) (64)	C	60
24	A515 Gr. 60	...	A671	CB60	K02401	...	...	1	(57) (64)	B	60
25	A515 Gr. 60	...	A672	B60	K02401	...	...	1	(57) (64)	B	60
26	A516 Gr. 60	...	A672	C60	K02100	...	...	1	(57) (64)	C	60
27	...	...	A139	B	K03003	...	...	1	(8b)	A	60
28	...	...	A135	B	K03018	...	...	1	(57) (59)	B	60
29	...	...	A524	I	K02104	...	...	1	(57)	−20	60
30	...	...	A53	B	K03005	...	...	1	(57) (59)	B	60

A106, Gr A

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Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Min. Yield Strength, ksi	Max. Temp., °F	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]															
			Min. Temp. to 100	200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100
																		Carbon Steel — Pipes and Tubes
1	24	900	15.0	14.7	14.2	13.7	13.0	12.3	11.9	11.5	10.7	9.2	7.9	5.9	...	...	...	...
2	24	1,100	15.0	14.7	14.2	13.7	13.0	12.3	11.9	11.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
3	25.4	400	15.0	15.0	14.7	14.2	...	...	...	...	...	...	...	...	...	...	...	...
4	25.4	400	15.0	15.0	14.7	14.2	...	...	...	...	...	...	...	...	...	...	...	...
5	26	1,100	15.7	15.7	15.3	14.8	14.1	13.3	12.8	12.4	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
6	30	400	16.0	16.0	16.0	16.0	...	...	...	...	...	...	...	...	...	...	...	...
7	30	300	16.0	16.0	16.0	...	...	...	...	...	...	...	...	...	...	...	...	...
8	30	850	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	...	...	...	...	...
9	30	1,100	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
A106, Gr A 10	30	1,100	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
11	30	1,100	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
12	30	1,100	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
13	30.5	1,100	16.0	16.0	16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
14	27	900	16.7	16.5	15.9	15.4	14.7	13.8	13.3	12.5	10.7	9.2	7.9	5.9	...	...	...	...
15	27	1,100	16.7	16.5	15.9	15.4	14.7	13.8	13.3	12.5	10.7	9.2	7.9	5.9	4.0	2.5	1.6	1.0
16	30	900	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	...	...	...	...
17	30	1,000	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...
18	30	1,100	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
19	30	1,100	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
20	30	1,100	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
21	30	1,100	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
22	30	1,100	18.3	18.3	17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
23	32	1,000	20.0	19.5	18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...
24	32	1,100	20.0	19.5	18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
25	32	1,100	20.0	19.5	18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
26	32	1,100	20.0	19.5	18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	1.6	1.0
27	35	300	20.0	20.0	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...
28	35	1,000	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...
29	35	1,000	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...
30	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0

Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Material	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Min. Tensile Strength, ksi
	Carbon Steel — Pipes and Tubes										
A106, Gr B 31	...	...	A106	B	K03006	...	...	1	(57)	B	60
32	...	...	A333	6	K03006	...	...	1	(57)	−50	60
33	...	...	A334	6	K03006	...	...	1	(57)	−50	60
34	...	...	A369	FPB	K03006	...	...	1	(57)	−20	60
35	...	...	A381	Y35	...	...	...	1	...	A	60
36	...	...	CSA Z245.1	241	...	...	...	1	(57)(59)	B	60
37	...	...	API 5L	B	...	PSL 1	...	1	(57) (59) (63)	B	60.2
38	...	...	API 5L	B	...	PSL 2	...	1	(57) (59) (63)	32	60.2
39	...	...	A139	C	K03004	...	...	1	(8b)	A	60
40	...		A139	D	K03010	...	...	1	(8b)	A	60
41	...	...	A381	Y42	...	...	...	1	...	A	60
42	...	...	CSA Z245.1	290	...	...	...	1	(55)	A	60
43	...	...	API 5L	X42	...	PSL 1	...	1	(55) (63)	A	60.2
44	...	...	API 5L	X42	...	PSL 2	...	1	(55) (63)	32	60.2
45	...	...	A381	Y48	...	...	...	1	(55) (63)	A	62
46	...	...	A381	Y46	...	...	...	1	...	A	63
47	...	...	API 5L	X46	...	PSL 1	...	1	(55) (63)	A	63.1
48	...	...	API 5L	X46	...	PSL 2	...	1	(55) (63)	32	63.1
49	...	...	A381	Y50	...	...	...	1	...	A	64
50	A516 Gr. 65	...	A671	CC65	K02403	...	...	1	(57) (64)	B	65
51	A515 Gr. 65	...	A671	CB65	K02800	...	...	1	(57) (64)	A	65
52	A515 Gr. 65	...	A672	B65	K02800	...	...	1	(57) (64)	A	65
53	A516 Gr. 65	...	A672	C65	K02403	...	...	1	(57) (64)	B	65
54	...	...	A139	E	K03012	...	...	1	(8b)	A	66
55	...	...	A381	Y52	...	...	...	1	...	A	66
56	...	...	CSA Z245.1	359	...	...	...	1	(55)	A	66
57	...	...	API 5L	X52	...	PSL 1	...	1	(55)(63)	A	66.7
58	...	...	API 5L	X52	...	PSL 2	...	1	(55)(63)	32	66.7
59	A516 Gr. 70	...	A671	CC70	K02700	...	...	1	(57) (64)	B	70
60	A515 Gr. 70	...	A671	CB70	K03101	...	...	1	(57) (64)	A	70
61	A515 Gr. 70	...	A672	B70	K03101	...	...	1	(57) (64)	A	70
62	A516 Gr. 70	...	A672	C70	K02700	...	...	1	(57) (64)	B	70

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Table A-1
Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Tables A-1 and A-1M; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Min. Yield Strength, ksi	Max. Temp., °F	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (2a)]															
			Min. Temp. to 100	200	300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100
			Carbon Steel — Pipes and Tubes (Cont'd)															
A106, Gr B 31	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
32	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
33	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
34	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
35	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
36	35	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
37	35.5	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
38	35.5	1,100	20.0	20.0	20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
39	42	300	20.0	20.0	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...
40	46	300	20.0	20.0	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...
41	42	400	20.0	20.0	20.0	20.0	...	...	...	...	...	...	...	...	...	...	...	...
42	42	500	20.0	20.0	20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...
43	42.1	500	20.1	20.1	20.1	20.1	19.8	...	...	...	...	...	...	...	...	...	...	...
44	42.1	500	20.1	20.1	201	20.1	19.8	...	...	...	...	...	...	...	...	...	...	...
45	48	650	20.7	20.7	20.7	20.7	20.7	20.7	18.7	...	...	...	...	...	...	...	...	...
46	46	500	21.0	21.0	21.0	21.0	...	...	...	...	...	...	...	...	...	...	...	...
47	46.4	500	21.0	21.0	21.0	21.0	21.0	...	...	...	...	...	...	...	...	...	...	...
48	46.4	500	21.0	21.0	21.0	21.0	21.0	...	...	...	...	...	...	...	...	...	...	...
49	50	650	21.3	21.3	21.3	21.3	21.3	21.3	18.7	...	...	...	...	...	...	...	...	...
50	35	1,000	21.7	21.4	20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...
51	35	1,100	21.7	21.4	20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
52	35	1,100	21.7	21.4	20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
53	35	1,100	21.7	21.4	20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	1.6	1.0
54	52	300	22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	...	...
55	52	400	22.0	22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	...
56	52	500	22.0	22.0	22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...
57	52.2	500	22.2	22.2	22.2	22.2	22.2	...	...	...	...	...	...	...	...	...	...	...
58	52.2	500	22.2	22.2	22.2	22.2	22.2	...	...	...	...	...	...	...	...	...	...	...
59	38	1,000	23.3	23.2	22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	...	...
60	38	1,100	23.3	23.2	22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0
61	38	1,100	23.3	23.2	22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0
62	38	1,100	23.3	23.2	22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0