Table A-1 Basic Allowable Stresses in Tension for Metals (20)

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
							Tensile	Yield	Min. Temp. to 100	200	300	400	500	600	650
Iron — Castings															
Gray	A48	20	F11401	...	(8e) (48)	−20	20	...	2.0	2.0	2.0	2.0	...	...	...
Gray	A278	20	F11401	...	(8e) (48)	−20	20	...	2.0	2.0	2.0	2.0	...	...	...
Gray	A126	A	F11501	...	(8e) (9) (48)	−20	21	...	2.0	2.0	2.0	2.0	...	...	...
Gray	A48	25	F11701	...	(8e) (48)	−20	25	...	2.5	2.5	2.5	2.5	...	...	...
Gray	A278	25	F11701	...	(8e) (48)	−20	25	...	2.5	2.5	2.5	2.5	...	...	...
Gray	A48	30	F12101	...	(8e) (48)	−20	30	...	3.0	3.0	3.0	3.0	...	...	...
Gray	A278	30	F12101	...	(8e) (48)	−20	30	...	3.0	3.0	3.0	3.0	...	...	...
Gray	A126	B	F12102	...	(8e) (9) (48)	−20	31	...	3.0	3.0	3.0	3.0	...	...	...
Gray	A48	35	F12401	...	(8e) (48)	−20	35	...	3.5	3.5	3.5	3.5	...	...	...
Gray	A278	35	F12401	...	(8e) (48)	−20	35	...	3.5	3.5	3.5	3.5	...	...	...
Gray	A48	40	F12801	...	(8e) (9) (48)	−20	40	...	4.0	4.0	4.0	4.0	...	...	...
Gray	A126	C	F12802	...	(8e) (9) (48)	−20	41	...	4.0	4.0	4.0	4.0	...	...	...
Gray	A278	40	F12803	...	(8e) (53)	−20	40	...	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Gray	A48	45	F13101	...	(8e) (48)	−20	45	...	4.5	4.5	4.5	4.5	...	...	...
Gray	A48	50	F13501	...	(8e) (48)	−20	50	...	5.0	5.0	5.0	5.0	...	...	...
Gray	A278	50	F13502	...	(8e) (53)	−20	50	...	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Gray	A48	55	F13801	...	(8e) (48)	−20	55	...	5.5	5.5	5.5	5.5	...	...	...
Gray	A48	60	F14101	...	(8e) (48)	−20	60	...	6.0	6.0	6.0	6.0	...	...	...
Gray	A278	60	F14102	...	(8e) (53)	−20	60	...	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Cupola malleable	A197	...	F22000	...	(8e) (9)	−20	40	30	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Malleable	A47	32510	F22200	...	(8e) (9)	−20	50	32.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Ferritic ductile	A395	60-40-18	F32800	...	(8d) (9)	−20	60	40	20.0	19.0	17.9	16.9	15.9	14.9	14.1
Austenitic ductile	A571	D-2M	F43010	1	(8d)	−20	65	30	20.0	...	...	...	...	...	...
Ductile	A536	65-45-12	F33100	...	(8d) (9)	−20	65	45	21.7	21.7	21.7	21.7	21.6	...	...

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Carbon Steel — Pipes and Tubes												
A285 Gr. A	A134	A285A	K01700	...	...	1	(8b) (57)	B	45	24	15.0	14.7
A285 Gr. A	A672	A45	K01700	...	...	1	(57) (59) (67)	B	45	24	15.0	14.7
Butt weld	API 5L	A25	...	...	...	1	(8a) (77)	−20	45	25	15.0	15.0
Smls & ERW	API 5L	A25	...	...	...	1	(57) (59) (77)	B	45	25	15.0	15.0
...	A179	...	K01200	...	...	1	(57) (59)	−20	47	26	15.7	15.7
Type F	A53	A	K02504	...	...	1	(8a)	20	48	30	16.0	16.0
...	A139	A	...	...	...	1	(8b)	A	48	30	16.0	16.0
...	A587	...	K11500	...	...	1	(57) (59)	−20	48	30	16.0	16.0
...	A53	A	K02504	...	...	1	(57) (59)	B	48	30	16.0	16.0
...	A106	A	K02501	...	...	1	(57)	B	48	30	16.0	16.0
...	A135	A	...	...	...	1	(57) (59)	B	48	30	16.0	16.0
...	A369	FPA	K02501	...	...	1	(57)	B	48	30	16.0	16.0
...	API 5L	A	...	...	...	1	(57) (59)	B	48	30	16.0	16.0
A285 Gr. B	A134	A285B	K02200	...	...	1	(8b) (57)	B	50	27	16.7	16.5
A285 Gr. B	A672	A50	K02200	...	...	1	(57) (59) (67)	B	50	27	16.7	16.5
A285 Gr. C	A134	A285C	K02801	...	...	1	(8b) (57)	A	55	30	18.3	18.3
...	A524	II	K02104	...	...	1	(57)	−20	55	30	18.3	18.3
...	A333	1	K03008	...	...	1	(57) (59)	−50	55	30	18.3	18.3
...	A334	1	K03008	...	...	1	(57) (59)	−50	55	30	18.3	18.3
A285 Gr. C	A671	CA55	K02801	...	...	1	(59) (67)	A	55	30	18.3	18.3
A285 Gr. C	A672	A55	K02801	...	...	1	(57) (59) (67)	A	55	30	18.3	18.3
A516 Gr. 55	A672	C55	K01800	...	...	1	(57) (67)	C	55	30	18.3	18.3
A516 Gr. 60	A671	CC60	K02100	...	...	1	(57) (67)	C	60	32	20.0	19.5
A515 Gr. 60	A671	CB60	K02401	...	...	1	(57) (67)	B	60	32	20.0	19.5
A515 Gr. 60	A672	B60	K02401	...	...	1	(57) (67)	B	60	32	20.0	19.5
A516 Gr. 60	A672	C60	K02100	...	...	1	(57) (67)	C	60	32	20.0	19.5
...	A139	B	K03003	...	...	1	(8b)	A	60	35	20.0	20.0
...	A135	B	K03018	...	...	1	(57) (59)	B	60	35	20.0	20.0
...	A524	I	K02104	...	...	1	(57)	−20	60	35	20.0	20.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]															
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	Type/ Grade	Spec. No.
														Carbon Steel — Pipes and Tubes	
14.2	13.7	13.0	12.3	11.9	11.5	10.7	9.2	7.9	5.9	...	...	...	...	...	A134
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	A45	A672
14.7	14.2	...	...	...	...	...	...	...	...	...	...	...	...	A25	API 5L
14.7	14.2	...	...	...	...	...	...	...	...	...	...	...	...	A25	API 5L
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	...	A179
16.0	16.0	...	...	...	...	...	...	...	...	...	...	...	...	A	A53
16.0	...	...	...	...	...	...	...	...	...	...	...	...	...	A	A139
16.0	16.0	16.0	15.3	14.6	12.5	10.7	9.2	7.9	...	...	...	...	...	...	A587
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	A	A53
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	A	A106
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	A	A135
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	FPA	A369
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	A	API 5L
15.9	15.4	14.7	13.8	13.3	12.5	10.7	9.2	7.9	5.9	...	...	...	...	...	A134
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	A50	A672
17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	...	...	...	...	...	A134
17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...	II	A524
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	1	A333
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	1	A334
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	CA55	A671
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	A55	A672
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	C55	A672
18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...	CC60	A671
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	CB60	A671
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	B60	A672
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	C60	A672
20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	B	A139
20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	B	A135
20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	I	A524

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Carbon Steel — Pipes and Tubes												
...	A53	B	K03005	...	...	1	(57) (59)	B	60	35	20.0	20.0
...	A106	B	K03006	...	...	1	(57)	B	60	35	20.0	20.0
...	A333	6	K03006	...	...	1	(57)	−50	60	35	20.0	20.0
...	A334	6	K03006	...	...	1	(57)	−50	60	35	20.0	20.0
...	A369	FPB	K03006	...	...	1	(57)	−20	60	35	20.0	20.0
...	A381	Y35	...	...	...	1	...	A	60	35	20.0	20.0
...	API 5L	B	...	...	...	1	(57) (59) (77)	B	60	35	20.0	20.0
...	A139	C	K03004	...	...	1	(8b)	A	60	42	20.0	20.0
...	A139	D	K03010	...	...	1	(8b)	A	60	46	20.0	20.0
...	API 5L	X42	...	...	...	1	(55) (77)	A	60	42	20.0	20.0
...	A381	Y42	...	...	...	1	...	A	60	42	20.0	20.0
...	A381	Y48	...	...	...	1	...	A	62	48	20.7	20.7
...	API 5L	X46	...	...	...	1	(55) (77)	A	63	46	21.0	21.0
...	A381	Y46	...	...	...	1	...	A	63	46	21.0	21.0
...	A381	Y50	...	...	...	1	...	A	64	50	21.3	21.3
A516 Gr. 65	A671	CC65	K02403	...	...	1	(57) (67)	B	65	35	21.7	21.4
A515 Gr. 65	A671	CB65	K02800	...	...	1	(57) (67)	A	65	35	21.7	21.4
A515 Gr. 65	A672	B65	K02800	...	...	1	(57) (67)	A	65	35	21.7	21.4
A516 Gr. 65	A672	C65	K02403	...	...	1	(57) (67)	B	65	35	21.7	21.4
...	A139	E	K03012	...	...	1	(8b)	A	66	52	22.0	22.0
...	API 5L	X52	...	...	...	1	(55) (77)	A	66	52	22.0	22.0
...	A381	Y52	...	...	...	1	...	A	66	52	22.0	22.0
A516 Gr. 70	A671	CC70	K02700	...	...	1	(57) (67)	B	70	38	23.3	23.2
A515 Gr. 70	A671	CB70	K03101	...	...	1	(57) (67)	A	70	38	23.3	23.2
A515 Gr. 70	A672	B70	K03101	...	...	1	(57) (67)	A	70	38	23.3	23.2
A516 Gr. 70	A672	C70	K02700	...	...	1	(57) (67)	B	70	38	23.3	23.2
...	A106	C	K03501	...	...	1	(57)	B	70	40	23.3	23.3
A537 Cl. 1	A671	CD70	K12437	...	≤2½ thk.	1	(67)	D	70	50	23.3	23.3
A537 Cl. 1	A672	D70	K12437	...	≤2½ thk.	1	(67)	D	70	50	23.3	23.3
A537 Cl. 1	A691	CMSH-70	K12437	...	≤2½ thk.	1	(67)	D	70	50	23.3	23.3
...	API 5L	X56	...	...	...	1	(51) (55) (71) (77)	A	71	56	23.7	23.7
...	A381	Y56	...	...	...	1	(51) (55) (71)	A	71	56	23.7	23.7

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]															
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	Type/ Grade	Spec. No.
														Carbon Steel — Pipes and Tubes (Cont'd)	
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	B	A53
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	B	A106
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	6	A333
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	6	A334
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	FPB	A369
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	Y35	A381
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	B	API 5L
20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	C	A139
20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	D	A139
20.0	20.0	...	...	...	...	...	...	...	...	...	...	...	...	X42	API 5L
20.0	20.0	...	...	...	...	...	...	...	.....	...	...	...	...	Y42	A381
20.7	20.7	20.7	20.7	18.7	...	...	...	...	...	...	...	...	...	Y48	A381
21.0	21.0	...	...	...	...	...	...	...	...	...	...	...	...	X46	API 5L
21.0	21.0	...	...	...	...	...	...	...	...	...	...	...	...	Y46	A381
21.3	21.3	21.3	21.3	18.7	...	...	...	...	...	...	...	...	...	Y50	A381
20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	CC65	A671
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	CB65	A671
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	B65	A672
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	C65	A672
22.0	...	...	...	...	...	...	...	...	...	...	...	...	...	E	A139
22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	...	X52	API 5L
22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	...	Y52	A381
22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	...	...	CC70	A671
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	CB70	A671
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	B70	A672
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	C70	A672
23.3	22.8	21.7	20.4	19.8	18.3	14.8	12.0	...	...	...	...	...	...	C	A106
22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...	CD70	A671
22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...	D70	A672
22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...	CMSH-70	A691
23.7	23.7	...	...	...	...	...	...	...	...	...	...	...	...	X56	API 5L
23.7	23.7	...	...	...	...	...	...	...	...	...	...	...	...	Y56	A381

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Carbon Steel — Pipes and Tubes												
A299 Gr. A	A671	CK75	K02803	...	>1 thk.	1	(57) (67)	A	75	40	25.0	24.4
A299 Gr. A	A672	N75	K02803	...	>1 thk.	1	(57) (67)	A	75	40	25.0	24.4
A299 Gr. A	A691	CMS-75	K02803	...	>1 thk.	1	(57) (67)	A	75	40	25.0	24.4
A299 Gr. A	A671	CK75	K02803	...	≤1 thk.	1	(57) (67)	A	75	42	25.0	25.0
A299 Gr. A	A672	N75	K02803	...	≤1 thk.	1	(57) (67)	A	75	42	25.0	25.0
A299 Gr. A	A691	CMS-75	K02803	...	≤1 thk.	1	(57) (67)	A	75	42	25.0	25.0
...	API 5L	X60	...	...	...	1	(51) (55) (71) (77)	A	75	60	25.0	25.0
...	API 5L	X65	...	...	...	1	(51) (55) (71) (77)	A	77	65	25.7	25.7
...	API 5L	X70	...	...	...	1	(51) (55) (71) (77)	A	82	70	27.3	27.3
...	API 5L	X80	...	...	...	1	(51) (55) (71) (77)	A	90	80	30.0	30.0
...	A381	Y60	...	...	...	1	(51) (71)	A	75	60	25.0	25.0
Carbon Steel — Pipes (Structural Grade)												
A1011 Gr. 30	A134	A1011SS30	K02502	...	...	1	(8a) (8c)	−20	49	30	15.0	15.0
A1011 Gr. 33	A134	A1011SS33	K02502	...	...	1	(8a) (8c)	−20	52	33	15.9	15.9
A1011 Gr. 36	A134	A1011SS36-T1	K02502	...	...	1	(8a) (8c)	−20	53	36	16.3	16.3
A1011 Gr. 40	A134	A1011SS40	K02502	...	...	1	(8a) (8c)	−20	55	40	16.9	16.9
A36	A134	A36	K02600	...	...	1	(8a) (8c)	−20	58	36	17.8	17.8
A283 Gr. D	A134	A283D	K02702	...	...	1	(8a) (8c)	−20	60	33	18.4	18.4
A1011 Gr. 45	A134	A1011SS45	K02507	...	...	1	(8a) (8c)	−20	60	45	18.4	18.4
A1011 Gr. 50	A134	A1011SS50	K02507	...	...	1	(8a) (8c)	−20	65	50	19.9	19.9
Carbon Steel — Plates, Bars, Shapes, and Sheets												
...	A285	A	K01700	...	...	1	(57) (59)	B	45	24	15.0	14.7
...	A285	B	K02200	...	...	1	(57) (59)	B	50	27	16.7	16.5
...	A516	55	K01800	...	...	1	(57)	C	55	30	18.3	18.3
...	A285	C	K02801	...	...	1	(57) (59)	A	55	30	18.3	18.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]															
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	Type/ Grade	Spec. No.
Carbon Steel — Pipes and Tubes (Cont'd)															
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	CK75	A671
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	N75	A672
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	CMS-75	A691
24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...	CK75	A671
24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...	N75	A672
24.8	23.9	22.8	21.5	20.8	19.6	...	...	...	...	...	...	...	...	CMS-75	A691
25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	...	X60	API 5L
25.7	25.7	...	...	...	...	...	...	...	...	...	...	...	...	X65	API 5L
27.3	27.3	...	...	...	...	...	...	...	...	...	...	...	...	X70	API 5L
30.0	30.0	...	...	...	...	...	...	...	...	...	...	...	...	X80	API 5L
25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	...	Y60	A381
Carbon Steel — Pipes (Structural Grade)															
15.0	15.0	...	...	...	...	...	...	...	...	...	...	...	...	A1011SS30	A134
15.9	15.9	...	...	...	...	...	...	...	...	...	...	...	...	A1011SS33	A134
16.3	16.3	...	...	...	...	...	...	...	...	...	...	...	...	A1011SS36-T1	A134
16.9	16.9	...	...	...	...	...	...	...	...	...	...	...	...	A1011SS40	A134
17.8	17.8	...	...	...	...	...	...	...	...	...	...	...	...	A36	A134
17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	A283D	A134
18.4	18.4	...	...	...	...	...	...	...	...	...	...	...	...	A1011SS45	A134
19.9	19.9	...	...	...	...	...	...	...	...	...	...	...	...	1011SS50	A134
Carbon Steel — Plates, Bars, Shapes, and Sheets															
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	A	A285
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	B	A285
17.7	17.1	16.3	15.3	14.8	14.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...	55	A516
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	C	A285

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Carbon Steel — Plates, Bars, Shapes, and Sheets												
...	A516	60	K02100	...	...	1	(57)	C	60	32	20.0	19.5
...	A515	60	K02401	...	...	1	(57)	B	60	32	20.0	19.5
...	A696	B	K03200	...	...	1	(57)	A	60	35	20.0	20.0
...	A516	65	K02403	...	...	1	(57)	B	65	35	21.7	21.4
...	A515	65	K02800	...	...	1	(57)	A	65	35	21.7	21.4
...	A516	70	K02700	...	...	1	(57)	B	70	38	23.3	23.2
...	A515	70	K03101	...	...	1	(57)	A	70	38	23.3	23.2
...	A696	C	K03200	...	...	1	(57)	A	70	40	23.3	23.3
...	A537	...	K12437	1	≤2½ thk.	1	...	D	70	50	23.3	23.3
...	A299	A	K02803	...	>1 thk.	1	(57)	A	75	40	25.0	24.4
...	A299	A	K02803	...	≤1 thk.	1	(57)	A	75	42	25.0	25.0
Carbon Steel — Plates, Bars, Shapes, and Sheets (Structural)												
...	A1011	SS30	K02502	...	...	1	(8c) (57)	A	49	30	15.0	15.0
...	A1011	SS33	K02502	...	...	1	(8c) (57)	A	52	33	15.9	15.9
...	A1011	SS36-T1	K02502	...	...	1	(8c) (57)	A	53	36	16.3	16.3
...	A283	C	K02401	...	...	1	(8c) (57)	A	55	30	16.8	16.8
...	A1011	SS40	K02502	...	...	1	(8c) (57)	A	55	40	16.8	16.8
...	A36	...	K02600	...	...	1	(8c)	A	58	36	17.8	17.8
...	A283	D	K02702	...	...	1	(8c) (57)	A	60	33	18.4	18.4
...	A1011	SS45	K02507	...	...	1	(8c) (57)	A	60	45	18.4	18.4
...	A1011	SS50	K02507	...	...	1	(8c) (57)	A	65	50	19.9	19.9
...	A992	...	...	...	...	1	(8c) (57)	A	65	50	19.9	19.9
Carbon Steel — Forgings and Fittings												
...	A350	LF1	K03009	...	...	1	(9) (57) (59)	−20	60	30	20.0	18.3
...	A181	...	K03502	60	...	1	(9) (57) (59)	A	60	30	20.0	18.3
...	A420	WPL6	K03006	...	...	1	(57)	−50	60	35	20.0	20.0
...	A234	WPB	K03006	...	...	1	(57) (59)	B	60	35	20.0	20.0
...	A694	F42	K03014	...	...	1	(9)	−20	60	42	20.0	20.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]															
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	Type/ Grade	Spec. No.
Carbon Steel — Plates, Bars, Shapes, and Sheets (Cont'd)															
18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...	60	A516
18.9	18.2	17.4	16.4	15.8	15.3	13.0	10.8	8.7	5.9	4.0	2.5	...	...	60	A515
20.0	19.9	19.0	17.9	17.3	15.6	...	...	...	...	...	...	...	...	B	A696
20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	65	A516
20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	65	A515
22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	...	...	70	A516
22.4	21.6	20.6	19.4	18.8	18.1	14.8	12.0	9.3	6.7	4.0	2.5	...	...	70	A515
23.3	22.8	21.7	20.5	19.7	18.3	...	...	...	...	...	...	...	...	C	A696
22.8	22.7	22.7	22.4	21.9	18.3	...	...	...	...	...	...	...	...	Cl. 1	A537
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	A	A299
24.8	23.9	22.8	21.5	20.8	19.6	15.7	12.6	9.3	6.7	4.0	2.5	1.6	1.0	A	A299
Carbon Steel — Plates, Bars, Shapes, and Sheets (Structural)															
15.0	15.0	15.0	14.1	13.4	11.5	9.8	...	...	...	...	...	...	...	30	A1011
15.9	15.9	15.9	15.5	13.4	11.5	9.8	...	...	...	...	...	...	...	33	A1011
16.3	16.3	16.3	16.3	13.4	11.5	9.8	...	...	...	...	...	...	...	36	A1011
16.3	15.7	15.0	14.1	13.6	13.2	12.0	...	...	...	...	...	...	...	C	A283
16.8	16.8	16.8	16.8	16.8	14.4	12.0	...	...	...	...	...	...	...	40	A1011
17.8	17.8	17.8	16.9	16.4	14.4	...	...	...	...	...	...	...	...	...	A36
17.9	17.3	16.5	15.5	15.0	14.5	12.8	...	...	...	...	...	...	...	D	A283
18.4	18.4	18.4	18.4	18.4	15.5	12.8	...	...	...	...	...	...	...	45	A1011
19.9	19.9	19.9	19.9	18.9	15.5	12.8	...	...	...	...	...	...	...	50	A1011
19.9	19.9	19.9	19.9	18.9	15.5	12.8	10.5	...	...	...	...	...	...	...	A992
Carbon Steel — Forgings and Fittings															
17.7	17.1	16.3	15.3	14.8	14.3	13.8	11.4	8.7	5.9	4.0	2.5	...	...	LF1	A350
17.7	17.1	16.3	15.3	14.8	14.3	13.8	11.4	8.7	5.9	4.0	2.5	1.6	1.0	Cl. 60	A181
20.0	19.9	19.0	17.9	17.3	16.7	13.9	11.4	8.7	5.9	4.0	2.5	...	...	WPL6	A420
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	WPB	A234
20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...	F42	A694

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Carbon Steel — Forgings and Fittings												
...	A707	L1	K02302	1	...	1	(9)	−20	60	42	20.0	20.0
...	A707	L2	K03301	1	...	1	(9)	−50	60	42	20.0	20.0
...	A707	L3	K12510	1	...	1	(9)	−50	60	42	20.0	20.0
...	A860	WPHY 42	...	...	...	1	...	−50	60	42	20.0	20.0
...	A694	F46	K03014	...	...	1	(9)	−20	63	46	21.0	21.0
...	A860	WPHY 46	...	...	...	1	...	−50	63	46	21.0	21.0
...	A694	F52	K03014	...	...	1	(9)	−20	66	52	22.0	22.0
...	A707	L1	K02302	2	...	1	(9)	−20	66	52	22.0	22.0
...	A707	L2	K03301	2	...	1	(9)	−50	66	52	22.0	22.0
...	A707	L3	K12510	2	...	1	(9)	−50	66	52	22.0	22.0
...	A860	WPHY 52	...	...	...	1	...	−50	66	52	22.0	22.0
...	A350	LF2	K03011	1	...	1	(9) (57)	−50	70	36	23.3	22.0
...	A350	LF2	K03011	2	...	1	(9) (57)	0	70	36	23.3	22.0
...	A105	...	K03504	...	...	1	(9) (57) (59)	−20	70	36	23.3	22.0
...	A181	...	K03502	70	...	1	(9) (57) (59)	A	70	36	23.3	22.0
...	A234	WPC	K03501	...	...	1	(57) (59)	B	70	40	23.3	23.3
...	A694	F56	K03014	...	...	1	(9)	−20	71	56	23.7	23.7
...	A694	F60	K03014	...	...	1	(9)	−20	75	60	25.0	25.0
...	A707	L2	K03301	3	...	1	(9)	−50	75	60	25.0	25.0
...	A707	L3	K12510	3	...	1	(9)	−50	75	60	25.0	25.0
...	A860	WPHY 60	...	...	...	1	...	−50	75	60	25.0	25.0
...	A694	F65	K03014	...	...	1	(9)	−20	77	65	25.7	25.7
...	A860	WPHY 65	...	...	...	1	...	−50	77	65	25.7	25.7
...	A694	F70	K03014	...	...	1	(9) (79)	...	82	70	27.3	27.3
...	A860	WPHY 70	...	...	...	1	...	−50	82	70	27.3	27.3
Carbon Steel — Castings												
...	A216	WCA	J02502	...	...	1	(57)	−20	60	30	20.0	18.3
...	A352	LCB	J03003	...	...	1	(9) (57)	−50	65	35	21.7	21.4
...	A352	LCC	J02505	...	...	1	(9)	−50	70	40	23.3	23.3
...	A216	WCB	J03002	...	...	1	(9) (57)	−20	70	36	23.3	22.0
...	A216	WCC	J02503	...	...	1	(9) (57)	−20	70	40	23.3	23.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]															
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	Type/ Grade	Spec. No.
														Carbon Steel — Forgings and Fittings (Cont'd)	
20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...	L1	A707
20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...	L2	A707
20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...	L3	A707
20.0	20.0	19.7	...	...	...	...	...	...	...	...	...	...	...	WPHY 42	A860
21.0	21.0	21.0	...	...	...	...	...	...	...	...	...	...	...	F46	A694
21.0	21.0	21.0	...	...	...	...	...	...	...	...	...	...	...	WPHY 46	A860
22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	F52	A694
22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	L1	A707
22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	L2	A707
22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	L3	A707
22.0	22.0	22.0	...	...	...	...	...	...	...	...	...	...	...	WPHY 52	A860
21.2	20.5	19.6	18.4	17.8	17.2	14.8	12.0	9.3	6.7	4.0	2.5	...	...	LF2 Cl. 1	A350
21.2	20.5	19.6	18.4	17.8	17.2	14.8	12.0	9.3	6.7	4.0	2.5	...	...	LF2 Cl. 2	A350
21.2	20.5	19.6	18.4	17.8	17.2	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0	...	A105
21.2	20.5	19.6	18.4	17.8	17.2	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0	Cl. 70	A181
23.3	22.8	21.7	20.4	19.8	18.3	14.8	12.0	...	...	...	...	...	...	WPC	A234
23.7	23.7	23.7	...	...	...	...	...	...	...	...	...	...	...	F56	A694
25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	F60	A694
25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	L2	A707
25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	L3	A707
25.0	25.0	25.0	...	...	...	...	...	...	...	...	...	...	...	WPHY 60	A860
25.7	25.7	25.7	...	...	...	...	...	...	...	...	...	...	...	F65	A694
25.7	25.7	25.7	...	...	...	...	...	...	...	...	...	...	...	WPHY 65	A860
27.3	27.3	...	...	...	...	...	...	...	...	...	...	...	...	F70	A694
27.3	27.3	...	...	...	...	...	...	...	...	...	...	...	...	WPHY 70	A860
														Carbon Steel — Castings	
17.7	17.1	16.3	15.3	14.8	14.3	13.8	11.4	8.7	5.9	4.0	2.5	1.6	1.0	WCA	A216
20.6	19.9	19.0	17.9	17.3	16.7	13.9	11.4	9.0	6.3	4.0	2.5	1.6	1.0	LCB	A352
23.3	22.8	21.7	20.4	19.8	19.2	...	...	...	...	...	...	...	...	LCC	A352
21.2	20.5	19.6	18.4	17.8	17.2	14.8	12.0	9.3	6.7	4.0	2.5	1.6	1.0	WCB	A216
23.3	22.8	21.7	20.4	19.8	18.3	14.8	12.0	9.3	6.7	4.0	2.5	...	...	WCC	A216

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Low and Intermediate Alloy Steel — Pipes												
½Cr–½Mo	A335	P2	K11547	...	...	3	...	−20	55	30	18.3	18.3
½Cr–½Mo A387 Gr. 2 Cl. 1	A691	½CR	K12143	...	...	3	(11) (67)	−20	55	33	18.3	18.3
C–½Mo	A335	P1	K11522	...	...	3	(58)	−20	55	30	18.3	18.3
C–½Mo	A369	FP1	K11522	...	...	3	(58)	−20	55	30	18.3	18.3
½Cr–½Mo	A369	FP2	K11547	...	...	3	...	−20	55	30	18.3	18.3
1Cr–½Mo A387 Gr. 12 Cl. 1	A691	1CR	K11757	...	...	4	(11) (67)	−20	55	33	18.3	18.3
½Cr–½Mo	A426	CP2	J11547	...	...	3	(10)	−20	60	30	20.0	18.8
1½Si–½Mo	A335	P15	K11578	...	...	3	...	−20	60	30	20.0	18.8
C–½Mo–Si	A426	CP15	J11522	...	...	3	(10)	−20	60	30	20.0	18.8
1Cr–½Mo	A426	CP12	J11562	...	...	4	(10)	−20	60	30	20.0	18.1
5Cr–1½Si–½Mo	A426	CP5b	J51545	...	...	5B	(10)	−20	60	30	20.0	18.1
3Cr–Mo	A426	CP21	J31545	...	...	5A	(10)	−20	60	30	20.0	18.7
¾Cr–¾Ni–Cu–Al	A333	4	K11267	...	...	4	...	−150	60	35	20.0	19.1
2Cr–½Mo	A369	FP3b	K21509	...	...	4	...	−20	60	30	20.0	18.7
1Cr–½Mo	A335	P12	K11562	...	...	4	...	−20	60	32	20.0	19.3
1Cr–½Mo	A369	FP12	K11562	...	...	4	...	−20	60	32	20.0	19.3
1¼Cr–½Mo–Si	A335	P11	K11597	...	...	4	...	−20	60	30	20.0	18.5
1¼Cr–½Mo–Si	A369	FP11	K11597	...	...	4	...	−20	60	30	20.0	18.5
1¼Cr–½Mo–Si A387 Gr. 11 Cl. 1	A691	1¼CR	K11789	...	...	4	(11) (67)	−20	60	35	20.0	20.0
5Cr–½Mo A387 Gr. 5 Cl. 1	A691	5CR	K41545	...	...	5B	(11) (67)	−20	60	30	20.0	18.1
5Cr–½Mo	A335	P5	K41545	...	...	5B	...	−20	60	30	20.0	18.1
5Cr–½Mo–Si	A335	P5b	K51545	...	...	5B	...	−20	60	30	20.0	18.1
5Cr–½Mo–Ti	A335	P5c	K41245	...	...	5B	...	−20	60	30	20.0	18.1
5Cr–½Mo	A369	FP5	K41545	...	...	5B	...	−20	60	30	20.0	18.1
9Cr–1Mo	A335	P9	K90941	...	...	5B	...	−20	60	30	20.0	18.1
9Cr–1Mo	A369	FP9	K90941	...	...	5B	...	−20	60	30	20.0	18.1
9Cr–1Mo A387 Gr. 9 Cl. 1	A691	9CR	K90941	...	...	5B	(11) (67)	−20	60	30	20.0	18.1

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																	
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	Type/ Grade	Spec. No.
Low and Intermediate Alloy Steel — Pipes																	
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.9	9.2	5.9	...	...	...	...	P2	A335
18.3	18.3	18.3	18.0	17.7	17.3	16.9	16.4	15.9	14.3	9.2	5.9	...	...	...	...	½CR	A691
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.7	8.2	4.8	4.0	2.4	...	...	P1	A335
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.7	8.2	4.8	4.0	2.4	...	...	FP1	A369
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.9	9.2	5.9	4.1	2.5	...	...	FP2	A369
17.6	17.6	17.2	16.8	16.5	16.3	16.0	15.7	15.4	15.0	11.3	7.2	4.5	2.8	1.8	1.1	1CR	A691
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.9	9.2	5.9	4.0	2.4	...	...	CP2	A426
18.2	17.7	17.3	16.8	16.6	16.3	15.9	15.4	13.8	12.5	10.0	6.3	4.0	2.4	...	...	P15	A335
18.2	17.7	17.3	16.8	16.6	16.3	15.9	15.4	13.8	12.5	10.0	6.3	4.0	2.4	...	...	CP15	A426
17.0	16.2	15.7	15.2	15.0	14.8	14.6	14.3	14.0	13.6	11.3	7.2	4.5	2.8	1.8	1.1	CP12	A426
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	CP5b	A426
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	16.0	12.0	9.0	7.0	5.5	4.0	2.7	1.5	CP21	A426
18.2	17.3	16.4	15.5	15.0	...	...	...	...	...	...	...	...	...	...	...	4	A333
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.5	12.5	10.0	6.2	4.2	2.6	1.4	1.0	FP3b	A369
18.1	17.3	16.7	16.3	16.0	15.8	15.5	15.3	14.9	14.5	11.3	7.2	4.5	2.8	1.8	1.1	P12	A335
18.1	17.3	16.7	16.3	16.0	15.8	15.5	15.3	14.9	14.5	11.3	7.2	4.5	2.8	1.8	1.1	FP12	A369
17.6	16.8	16.2	15.7	15.4	15.1	14.8	14.4	14.0	13.6	9.3	6.3	4.2	2.8	1.9	1.2	P11	A335
17.6	16.8	16.2	15.7	15.4	15.1	14.8	14.4	14.0	13.6	9.3	6.3	4.2	2.8	1.9	1.2	FP11	A369
20.0	19.6	18.9	18.3	18.0	17.6	17.2	16.8	16.4	13.7	9.3	6.3	4.2	2.8	1.9	1.2	1¼CR	A691
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	5CR	A691
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	P5	A335
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	P5b	A335
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	P5c	A335
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	FP5	A369
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.8	14.1	10.6	7.4	5.0	3.3	2.2	1.5	P9	A335
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.8	14.1	10.6	7.4	5.0	3.3	2.2	1.5	FP9	A369
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.8	14.1	10.6	7.4	5.0	3.3	2.2	1.5	9CR	A691

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Low and Intermediate Alloy Steel — Pipes												
3Cr–1Mo	A335	P21	K31545	...	...	5A	...	−20	60	30	20.0	18.7
3Cr–1Mo	A369	FP21	K31545	...	...	5A	...	−20	60	30	20.0	18.7
3Cr–1Mo A387 Gr. 21 Cl. 1	A691	3CR	K31545	...	...	5A	(11) (67)	−20	60	30	20.0	18.5
2¼Cr–1Mo A387 Gr. 22 Cl. 1	A691	2¼CR	K21590	...	...	5A	(11) (67) (72) (75)	−20	60	30	20.0	18.7
2¼Cr–1Mo	A369	FP22	K21590	...	...	5A	(72) (75)	−20	60	30	20.0	18.7
2¼Cr–1Mo	A335	P22	K21590	...	...	5A	(72) (75)	−20	60	30	20.0	18.7
2Ni–1Cu	A333	9	K22035	...	...	9A	...	−100	63	46	21.0	...
2Ni–1Cu	A334	9	K22035	...	...	9A	...	−100	63	46	21.0	...
2¼Ni	A333	7	K21903	...	...	9A	...	−100	65	35	21.7	21.4
2¼Ni	A334	7	K21903	...	...	9A	...	−100	65	35	21.7	21.4
3½Ni	A333	3	K31918	...	...	9B	...	−150	65	35	21.7	21.4
3½Ni	A334	3	K31918	...	...	9B	...	−150	65	35	21.7	21.4
C–½Mo	A426	CP1	J12521	...	...	3	(10) (58)	−20	65	35	21.7	21.7
C–½Mo A204 Gr. A	A672	L65	K11820	...	...	3	(11) (58) (67)	−20	65	37	21.7	21.7
C–½Mo A204 Gr. A	A691	CM-65	K11820	...	...	3	(11) (58) (67)	−20	65	37	21.7	21.7
2¼Ni A203 Gr. B	A671	CFB70	K22103	...	...	9A	(11) (65) (67)	−20	70	40	23.3	...
3½Ni A203 Gr. E	A671	CFE70	K32018	...	...	9B	(11) (65) (67)	−20	70	40	23.3	...
C–½Mo A204 Gr. B	A672	L70	K12020	...	...	3	(11) (58) (67)	−20	70	40	23.3	23.3
C–½Mo A204 Gr. B	A691	CM-70	K12020	...	...	3	(11) (58) (67)	−20	70	40	23.3	23.3
1¼Cr–½Mo	A426	CP11	J12072	...	...	4	(10)	−20	70	40	23.3	23.3
2¼Cr–1Mo	A426	CP22	J21890	...	...	5A	(10) (72)	−20	70	40	23.3	23.3
C–½Mo A204 Gr. C	A672	L75	K12320	...	...	3	(11) (58) (67)	−20	75	43	25.0	25.0
C–½Mo A204 Gr. C	A691	CM-75	K12320	...	...	3	(11) (58) (67)	−20	75	43	25.0	25.0
9Cr–1Mo–V	A335	P91	K90901	...	≤3 thk.	15E	...	−20	85	60	28.3	28.3
9Cr–1Mo–V	A691	91	K90901	...	≤3 thk.	15E	(11) (67)	−20	85	60	28.3	28.3
5Cr–½Mo	A426	CP5	J42045	...	...	5B	(10)	−20	90	60	30.0	29.9
9Cr–1Mo	A426	CP9	J82090	...	...	5B	(10)	−20	90	60	30.0	29.9
9Ni	A333	8	K81340	...	...	11A	(47)	−320	100	75	33.3	33.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																	
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	Type/ Grade	Spec. No.
																Low and Intermediate Alloy Steel — Pipes (Cont'd)	
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	16.0	12.0	9.0	7.0	5.5	4.0	2.7	1.5	P21	A335
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	16.0	12.0	9.0	7.0	5.5	4.0	2.7	1.5	FP21	A369
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	16.0	12.0	9.0	7.0	5.5	4.0	2.7	1.5	3CR	A691
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	2¼CR	A691
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	FP22	A369
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	P22	A335
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	A333
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	A334
20.6	19.9	18.9	17.5	16.7	15.7	13.9	11.4	9.0	6.5	4.5	2.5	1.6	1.0	...	...	7	A333
20.6	19.9	18.9	17.5	16.7	15.7	13.9	11.4	9.0	6.5	4.5	2.5	1.6	1.0	...	...	7	A334
20.6	19.9	18.9	17.5	16.7	15.7	13.9	11.4	9.0	6.5	4.5	2.5	1.6	1.0	...	...	3	A333
20.6	19.9	18.9	17.5	16.7	15.7	13.9	11.4	9.0	6.5	4.5	2.5	1.6	1.0	...	...	3	A334
21.0	20.3	19.7	19.1	18.7	18.4	17.9	17.4	16.9	13.7	8.2	4.8	4.0	2.4	...	...	CP1	A426
21.7	21.5	20.8	20.2	19.8	19.4	19.0	18.4	17.9	13.7	8.2	4.8	4.0	2.4	...	...	L65	A672
21.7	21.5	20.8	20.2	19.8	19.4	19.0	18.4	17.9	13.7	8.2	4.8	4.0	2.4	...	...	CM-65	A691
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CFB70	A671
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CFE70	A671
23.3	23.2	22.5	21.8	21.4	21.0	20.5	19.9	19.3	13.7	8.2	4.8	4.0	2.4	...	...	L70	A672
23.3	23.2	22.5	21.8	21.4	21.0	20.5	19.9	19.3	13.7	8.2	4.8	4.0	2.4	...	...	CM-70	A691
23.3	22.5	21.7	20.9	20.5	20.1	19.7	19.2	18.7	13.7	9.3	6.3	4.2	2.8	1.9	1.2	CP11	A426
22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	21.9	15.8	11.4	7.8	5.1	3.2	2.0	1.2	CP22	A426
25.0	25.0	24.2	23.4	23.0	22.6	22.0	21.4	20.7	13.7	8.2	4.8	4.0	2.4	...	...	L75	A672
25.0	25.0	24.2	23.4	23.0	22.6	22.0	21.4	20.7	13.7	8.2	4.8	4.0	2.4	...	...	CM-75	A691
28.3	28.2	28.1	27.7	27.3	26.7	25.9	24.9	23.7	22.3	20.7	18.0	14.0	10.3	7.0	4.3	P91	A335
28.3	28.2	28.1	27.7	27.3	26.7	25.9	24.9	23.7	22.3	20.7	18.0	14.0	10.3	7.0	4.3	91	A691
29.1	28.8	28.7	28.3	27.9	27.3	26.5	25.5	24.2	16.4	11.0	7.4	5.0	3.3	2.2	1.5	CP5	A426
29.1	28.8	28.7	28.3	27.9	27.3	26.5	25.5	24.2	16.4	11.0	7.4	5.0	3.8	2.2	1.5	CP9	A426
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	A333

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Low and Intermediate Alloy Steel — Pipes												
9Ni	A334	8	K81340	...	...	11A	...	−320	100	75	33.3	33.3
Low and Intermediate Alloy Steel — Plates												
½Cr–½Mo	A387	2	K12143	1	...	3	...	−20	55	33	18.3	18.3
1Cr–½Mo	A387	12	K11757	1	...	4	...	−20	55	33	18.3	18.0
9Cr–1Mo	A387	9	K90941	1	...	5B	...	−20	60	30	20.0	18.1
1¼Cr–½Mo–Si	A387	11	K11789	1	...	4	...	−20	60	35	20.0	20.0
5Cr–½Mo	A387	5	K41545	1	...	5B	...	−20	60	30	20.0	18.1
3Cr–1Mo	A387	21	K31545	1	...	5A	...	−20	60	30	20.0	18.3
2¼Cr–1Mo	A387	22	K21590	1	...	5A	(72)	−20	60	30	20.0	18.7
2¼Ni	A203	A	K21703	...	...	9A	(12) (65)	−20	65	37	21.7	21.7
3½Ni	A203	D	K31718	...	...	9B	(12) (65)	−20	65	37	21.7	21.7
C–½Mo	A204	A	K11820	...	...	3	(58)	−20	65	37	21.7	21.7
1Cr–½Mo	A387	12	K11757	2	...	4	...	−20	65	40	21.7	21.3
2¼Ni	A203	B	K22103	...	...	9A	(12) (65)	−20	70	40	23.3	23.3
3½Ni	A203	E	K32018	...	...	9B	(12) (65)	−20	70	40	23.3	23.3
½Cr–½Mo	A387	2	K12143	2	...	3	...	−20	70	45	23.3	23.3
C–½Mo	A204	B	K12020	...	...	3	(58)	−20	70	40	23.3	23.3
Mn–½Mo	A302	A	K12021	...	...	3	...	−20	75	45	25.0	25.0
C–½Mo	A204	C	K12320	...	...	3	(58)	−20	75	43	25.0	25.0
1¼Cr–½Mo–Si	A387	11	K11789	2	...	4	...	−20	75	45	25.0	25.0
5Cr–½Mo	A387	5	K41545	2	...	5B	...	−20	75	45	25.0	24.9
3Cr–1Mo	A387	21	K31545	2	...	5A	...	−20	75	45	25.0	25.0
2¼Cr–1Mo	A387	22	K21590	2	...	5A	(72)	−20	75	45	25.0	25.0
Mn–½Mo	A302	B	K12022	...	...	3	...	−20	80	50	26.7	26.7
Mn–½Mo–½Ni	A302	C	K12039	...	...	3	...	−20	80	50	26.7	26.7
Mn–½Mo–¾Ni	A302	D	K12054	...	...	3	...	−20	80	50	26.7	26.7
9Cr–1Mo–V	A387	91	K90901	2	≤3 thk.	15E	...	−20	85	60	28.3	28.3
8Ni	A553	II	K71340	...	...	11A	(47)	−275	100	85	33.3	...
5Ni–¼Mo	A645	A	K41583	...	...	11A	...	−275	95	65	31.7	31.7
9Ni	A553	I	K81340	...	...	11A	(47)	−320	100	85	33.3	33.3
9Ni	A353	...	K81340	...	...	11A	(47)	−320	100	75	33.3	33.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																	
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	Type/ Grade	Spec. No.
Low and Intermediate Alloy Steel — Pipes (Cont'd)																	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	A334
Low and Intermediate Alloy Steel — Plates																	
18.3	18.3	18.3	18.0	17.7	17.3	16.9	16.4	15.9	14.3	9.2	5.9	...	...	...	...	2 Cl. 1	A387
17.6	17.6	17.2	16.8	16.5	16.3	16.0	15.7	15.4	15.0	11.3	7.2	4.5	2.8	1.8	1.1	12 Cl. 1	A387
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.8	14.1	10.6	7.4	5.0	3.3	2.2	1.5	9 Cl. 1	A387
20.0	19.6	18.9	18.3	18.0	17.6	17.2	16.8	16.4	13.7	9.3	6.3	4.2	2.8	1.9	1.2	11 Cl. 1	A387
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	5 Cl. 1	A387
17.5	17.0	16.6	16.2	16.0	15.8	15.5	15.2	14.9	12.0	9.0	7.0	5.5	4.0	2.7	1.5	21 Cl. 1	A387
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	22 Cl. 1	A387
21.7	21.1	20.0	18.5	17.6	16.6	13.9	11.4	9.0	6.5	4.5	2.5	...	...	...	...	A	A203
21.7	21.1	20.0	18.5	17.6	16.6	13.9	11.4	9.0	6.5	4.5	2.5	...	...	...	...	D	A203
21.7	21.5	20.8	20.2	19.8	19.4	19.0	18.4	17.9	13.7	8.2	4.8	4.0	2.4	...	...	A	A204
20.8	20.8	20.8	20.3	20.0	19.7	19.4	19.1	18.6	18.0	11.3	7.2	4.5	2.8	1.8	1.1	12 Cl. 2	A387
23.3	22.8	21.6	20.0	19.0	16.9	13.9	11.4	9.0	6.5	4.5	2.5	...	...	...	...	B	A203
23.3	22.8	21.6	20.0	19.0	18.0	14.8	12.0	9.3	6.5	4.5	2.5	...	...	...	...	E	A203
23.3	23.3	23.3	23.3	23.3	23.3	23.1	22.4	21.7	20.9	9.2	5.9	...	...	...	...	2 Cl. 2	A387
23.3	23.2	22.5	21.8	21.4	21.0	20.5	19.9	19.3	13.7	8.2	4.8	4.0	2.4	...	...	B	A204
25.0	25.0	25.0	25.0	24.9	24.4	23.9	23.2	20.0	13.7	8.2	4.8	...	...	...	...	A	A302
25.0	25.0	24.2	23.4	23.0	22.6	22.0	21.4	20.7	13.7	8.2	4.8	4.0	2.4	...	...	C	A204
25.0	25.0	24.4	23.5	23.1	22.6	22.2	21.6	20.2	13.7	9.3	6.3	4.2	2.8	1.9	1.2	11 Cl. 2	A387
24.2	24.0	24.0	23.6	23.2	22.7	16.5	16.0	15.1	10.9	8.0	5.8	4.2	2.9	1.8	1.0	5 Cl. 2	A387
24.2	24.2	24.2	24.2	24.2	24.2	24.2	24.2	18.1	13.1	9.5	6.8	4.9	3.2	2.4	1.3	21 Cl. 2	A387
24.3	24.1	24.0	23.8	23.6	23.4	23.0	22.5	21.9	15.8	11.4	7.8	5.1	3.2	2.0	1.2	22 Cl. 2	A387
26.7	26.7	26.7	26.7	26.7	26.7	26.5	25.7	20.0	13.7	8.2	4.8	...	...	...	...	B	A302
26.7	26.7	26.7	26.7	26.7	26.7	26.5	25.7	20.0	13.7	8.2	4.8	...	...	...	...	C	A302
26.7	26.7	26.7	26.7	26.7	26.7	26.5	25.7	20.0	13.7	8.2	4.8	...	...	...	...	D	A302
28.3	28.2	28.1	27.7	27.3	26.7	25.9	24.9	23.7	22.3	20.7	18.0	14.0	10.3	7.0	4.3	91 Cl. 2	A387
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	II	A553
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A	A645
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	A553
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A353

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Low and Intermediate Alloy Steel — Forgings and Fittings												
C–½Mo	A234	WP1	K12821	...	...	3	(58)	−20	55	30	18.3	18.3
1Cr–½Mo	A182	F12	K11562	1	...	4	(9)	−20	60	32	20.0	19.3
1Cr–½Mo	A234	WP12	K12062	1	...	4	...	−20	60	32	20.0	19.3
1¼Cr–½Mo–Si	A182	F11	K11597	1	...	4	(9)	−20	60	30	20.0	18.5
1¼Cr–½Mo–Si	A234	WP11	K11597	1	...	4	...	−20	60	30	20.0	18.5
2¼Cr–1Mo	A182	F22	K21590	1	...	5A	(9) (72) (75)	−20	60	30	20.0	18.7
2¼Cr–1Mo	A234	WP22	K21590	1	...	5A	(72)	−20	60	30	20.0	18.7
5Cr–½Mo	A234	WP5	K41545	...	...	5B	...	−20	60	30	20.0	18.1
9Cr–1Mo	A234	WP9	K90941	...	...	5B	...	−20	60	30	20.0	18.1
3½Ni	A420	WPL3	K31918	...	...	9B	...	−150	65	35	21.7	21.4
3½Ni	A350	LF3	K32025	...	...	9B	(9)	−150	70	37.5	23.3	22.9
½Cr–½Mo	A182	F2	K12122	...	...	3	(9)	−20	70	40	23.3	23.3
C–½Mo	A182	F1	K12822	...	...	3	(9) (58)	−20	70	40	23.3	23.3
1Cr–½Mo	A182	F12	K11564	2	...	4	(9)	−20	70	40	23.3	22.9
1Cr–½Mo	A234	WP12	K12062	2	...	4	...	−20	70	40	23.3	22.9
1¼Cr–½Mo–Si	A182	F11	K11572	2	...	4	(9)	−20	70	40	23.3	23.3
1¼Cr–½Mo–Si	A234	WP11	K11572	2	...	4	...	−20	70	40	23.3	23.3
5Cr–½Mo	A182	F5	K41545	...	...	5B	(9)	−20	70	40	23.3	23.3
3Cr–1Mo	A182	F21	K31545	...	...	5A	(9)	−20	75	45	25.0	25.0
2¼Cr–1Mo	A182	F22	K21590	3	...	5A	(9) (72)	−20	75	45	25.0	25.0
2¼Cr–1Mo	A234	WP22	K21590	3	...	5A	(72)	−20	75	45	25.0	25.0
9Cr–1Mo	A182	F9	K90941	...	...	5B	(9)	−20	85	55	28.3	28.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																	
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	Type/ Grade	Spec. No.
Low and Intermediate Alloy Steel — Forgings and Fittings																	
18.0	17.4	16.9	16.4	16.1	15.7	15.4	14.9	14.5	13.7	8.2	4.8	4.0	2.4	...	...	WP1	A234
18.1	17.3	16.7	16.3	16.0	15.8	15.5	15.3	14.9	14.5	11.3	7.2	4.5	2.8	1.8	1.1	F12 Cl. 1	A182
18.1	17.3	16.7	16.3	16.0	15.8	15.5	15.3	14.9	14.5	11.3	7.2	4.5	2.8	1.8	1.1	WP12 Cl. 1	A234
17.6	16.8	16.2	15.7	15.4	15.1	14.8	14.4	14.0	13.6	9.3	6.3	4.2	2.8	1.9	1.2	F11 Cl. 1	A182
17.6	16.8	16.2	15.7	15.4	15.1	14.8	14.4	14.0	13.6	9.3	6.3	4.2	2.8	1.9	1.2	WP11 Cl. 1	A234
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	F22 Cl. 1	A182
18.2	18.0	17.9	17.9	17.9	17.9	17.9	17.7	17.1	13.6	10.8	8.0	5.7	3.8	2.4	1.4	WP22 Cl. 1	A234
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	WP5	A234
17.4	17.2	17.1	16.8	16.6	16.3	15.9	15.4	14.8	14.1	11.0	7.4	5.0	3.3	2.2	1.5	WP9	A234
20.6	19.9	18.9	17.5	16.7	...	...	...	...	...	...	...	...	...	...	...	WPL3	A420
22.1	21.4	20.3	18.8	17.9	...	...	...	...	...	...	...	...	...	...	...	LF3	A350
23.3	23.2	22.5	21.8	21.4	21.0	20.5	19.9	19.3	18.6	9.2	5.9	...	...	...	...	F2	A182
23.3	23.2	22.5	21.8	21.4	21.0	20.5	19.9	19.3	13.7	8.2	4.8	4.0	2.4	...	...	F1	A182
22.4	21.7	20.9	20.3	20.0	19.7	19.4	19.1	18.6	18.0	11.3	7.2	4.5	2.8	1.8	1.1	F12 Cl. 2	A182
22.4	21.7	20.9	20.3	20.0	19.7	19.4	19.1	18.6	18.0	11.3	7.2	4.5	2.8	1.8	1.1	WP12 Cl. 2	A234
23.3	22.5	21.7	20.9	20.5	20.1	19.7	19.2	18.7	13.7	9.3	6.3	4.2	2.8	1.9	1.2	F11 Cl. 2	A182
23.3	22.5	21.7	20.9	20.5	20.1	19.7	19.2	18.7	13.7	9.3	6.3	4.2	2.8	1.9	1.2	WP11 Cl. 2	A234
22.6	22.4	22.4	22.0	21.7	21.2	20.6	19.8	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	F5	A182
24.3	24.1	24.0	23.8	23.6	23.4	23.0	22.5	18.1	13.1	9.5	6.8	4.9	3.2	2.4	1.3	F21	A182
24.2	24.2	24.2	24.2	24.2	24.2	24.2	24.2	21.9	15.8	11.4	7.8	5.1	3.2	2.0	1.2	F22 Cl. 3	A182
24.2	24.2	24.2	24.2	24.2	24.2	24.2	24.2	21.9	15.8	11.4	7.8	5.1	3.2	2.0	1.2	WP22 Cl. 3	A234
27.4	27.2	27.1	26.8	26.3	25.8	25.0	24.0	22.9	15.2	10.6	7.4	5.0	3.3	2.2	1.5	F9	A182

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]	
									Tensile	Yield	Min. Temp. to 100	200
Low and Intermediate Alloy Steel — Forgings and Fittings												
9Cr–1Mo–V	A182	F91	K90901	...	≤3 thk.	15E	...	−20	85	60	28.3	28.3
9Cr–1Mo–V	A234	WP91	K90901	...	≤3 thk.	15E	...	−20	85	60	28.3	28.3
5Cr–½Mo	A182	F5a	K42544	...	...	5B	(9)	−20	90	65	30.0	29.9
9Ni	A420	WPL8	K81340	...	...	11A	(47)	−320	100	75	33.3	33.3
Low and Intermediate Alloy Steel — Castings												
C–½Mo	A352	LC1	J12522	...	...	3	(9) (58)	−75	65	35	21.7	21.7
C–½Mo	A217	WC1	J12524	...	...	3	(9) (58)	−20	65	35	21.7	21.7
2½Ni	A352	LC2	J22500	...	...	9A	(9)	−100	70	40	23.3	23.3
3½Ni	A352	LC3	J31550	...	...	9B	(9)	−150	70	40	23.3	23.3
1Ni–½Cr–½Mo	A217	WC4	J12082	...	...	4	(9)	−20	70	40	23.3	23.3
¾Ni–1Mo–¾Cr	A217	WC5	J22000	...	...	4	(9)	−20	70	40	23.3	23.3
1¼Cr–½Mo	A217	WC6	J12072	...	...	4	(9)	−20	70	40	23.3	23.3
2¼Cr–1Mo	A217	WC9	J21890	...	...	5A	(9)	−20	70	40	23.3	23.3
5Cr–½Mo	A217	C5	J42045	...	...	5B	(9)	−20	90	60	30.0	29.9
9Cr–1Mo	A217	C12	J82090	...	...	5B	(9)	−20	90	60	30.0	29.9

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																	
300	400	500	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	Type/ Grade	Spec. No.
Low and Intermediate Alloy Steel — Forgings and Fittings (Cont'd)																	
28.3	28.2	28.1	27.7	27.3	26.7	25.9	24.9	23.7	22.3	20.7	18.0	14.0	10.3	7.0	4.3	F91	A182
28.3	28.2	28.1	27.7	27.3	26.7	25.9	24.9	23.7	22.3	20.7	18.0	14.0	10.3	7.0	4.3	WP91	A234
29.1	28.8	28.7	28.3	27.9	27.3	26.5	25.5	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	F5a	A182
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPL8	A420
Low and Intermediate Alloy Steel — Castings																	
21.0	20.3	19.7	19.1	18.7	18.4	...	...	...	...	...	...	...	...	...	...	LC1	A352
21.0	20.3	19.7	19.1	18.7	18.4	17.9	17.4	16.9	13.7	8.2	4.8	4.0	2.4	...	...	WC1	A217
23.3	22.8	21.6	20.0	19.0	...	...	...	...	...	...	...	...	...	...	...	LC2	A352
23.3	22.8	21.6	20.0	19.0	...	...	...	...	...	...	...	...	...	...	...	LC3	A352
23.3	23.3	23.0	22.4	22.1	21.7	21.2	20.6	19.8	14.3	9.2	5.9	...	...	...	...	WC4	A217
23.3	23.3	23.0	22.4	22.1	21.7	21.2	20.6	19.8	14.3	9.2	5.9	4.0	2.4	...	...	WC5	A217
23.3	22.5	21.7	20.9	20.5	20.1	19.7	19.2	18.7	13.7	9.3	6.3	4.2	2.8	1.9	1.2	WC6	A217
22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	21.9	15.8	11.4	7.8	5.1	3.2	2.0	1.2	WC9	A217
29.1	28.8	28.7	28.3	27.9	27.3	26.5	25.5	14.3	10.9	8.0	5.8	4.2	2.9	1.8	1.0	C5	A217
29.1	28.8	28.7	28.3	27.9	27.3	26.5	25.5	24.2	15.2	10.6	7.4	5.0	3.3	2.2	1.5	C12	A217

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Pipes and Tubes (3)(4a)															
18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	>3/8 thk.	8	(28)	−425	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	>3/8 thk.	8	(28) (36)	−425	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–8Ni	Tube	A213	TP304L	S30403	...	...	8	(14) (36)	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
18Cr–8Ni	Tube	A269	TP304L	S30403	...	...	8	(14) (36)	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
18Cr–8Ni	Tube	A270	TP304L	S30403	...	...	8	(14)	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
18Cr–8Ni	Pipe	A312	TP304L	S30403	...	...	8	...	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
18Cr–8Ni	Pipe	A358	304L	S30403	...	...	8	(36)	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
16Cr–12Ni–2Mo	Tube	A213	TP316L	S31603	...	...	8	(14) (36)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo	Tube	A269	TP316L	S31603	...	...	8	(14) (36)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo	Tube	A270	TP316L	S31603	...	...	8	(14)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo	Pipe	A312	TP316L	S31603	...	...	8	...	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo	Pipe	A358	316L	S31603	...	...	8	(36)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo–Ti	Tube	A213	TP316Ti	S31635	...	...	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	>3/8 thk.	8	(28) (30)	−425	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	>3/8 thk.	8	(28) (30) (36)	−425	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Smls. pipe	A312	TP321H	S32109	...	>3/8 thk.	8	(30)	−325	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321H	S32109	...	>3/8 thk.	8	(30) (36)	−325	70	25	16.7	*16.7*	*16.7*	*16.7*
25Cr–12Ni	...	A451	CPH8	J93400	...	...	8	(26) (28) (35)	−325	65	28	18.7	*18.7*	*18.5*	*18.0*
25Cr–20Ni	...	A451	CPK20	J94202	...	...	8	(12) (28) (35) (39)	−325	65	28	18.7	*18.7*	*18.5*	*18.0*
11Cr–Ti	Tube	A268	TP409	S40900	...	...	7	(35)	−20	60	30	20.0	...	...	...
18Cr–Ti	Tube	A268	TP430Ti	S43036	...	...	7	(35) (49)	−20	60	40	20.0	...	...	...
16Cr–14Ni–2Mo	...	A451	CPF10MC	J92971	...	...	8	(28)	−325	70	30	20.0	...	...	...
12Cr–Al	Tube	A268	TP405	S40500	...	...	7	(35)	−20	60	30	20.0	20.0	19.6	19.3
13Cr	Tube	A268	TP410	S41000	...	...	6	(35)	−20	60	30	20.0	20.0	19.6	19.3
17Cr	Tube	A268	TP430	S43000	...	...	7	(35) (49)	−20	60	35	20.0	20.0	19.6	19.3
18Cr–13Ni–3Mo	Pipe	A312	TP317L	S31703	...	...	8	...	−325	75	30	20.0	*20.0*	*20.0*	**18.9**
25Cr–20Ni	Pipe	A312	TP310S	S31008	...	...	8	(28) (35)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	...	A358	310S	S31008	...	...	8	(28) (35) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	Pipe	A409	TP310S	S31008	...	...	8	(28) (31) (35) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	≤3/8 thk.	8	(28)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A312	TP321	S32100	...	...	8	(28)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A358	321	S32100	...	...	8	(28) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	≤3/8 thk.	8	(28) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A409	TP321	S32100	...	...	8	(28) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
23Cr–12Ni	Pipe	A312	TP309	...	...	...	8	(28) (35) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
																				Stainless Steel — Pipes and Tubes (3)(4a)	
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	TP321	A312
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	TP321	A376
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	TP304L	A213
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	TP304L	A269
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	TP304L	A270
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	TP304L	A312
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	A358
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	TP316L	A213
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	TP316L	A269
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	TP316L	A270
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	TP316L	A312
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	A358
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	TP316Ti	A213
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	TP321	A312
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	TP321	A376
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	TP321H	A312
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	TP321H	A376
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	CPH8	A451
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	CPK20	A451
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	TP409	A268
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	TP430Ti	A268
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CPF10MC	A451
19.0	18.5	18.1	17.7	17.1	16.4	15.6	14.3	8.4	4.0	...	...	...	...	...	...	...	...	...	...	TP405	A268
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	...	...	...	...	...	...	TP410	A268
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	...	...	...	...	...	...	TP430	A268
17.7	**16.9**	**16.5**	**16.2**	**15.8**	**15.5**	**15.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	TP317L	A312
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	TP310S	A312
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	310S	A358
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	TP310S	A409
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	TP321	A312
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	TP321	A312
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	321	A358
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	TP321	A376
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	TP321	A409
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	TP309	A312

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Pipes and Tubes (3)(4a)															
23Cr–12Ni	...	A358	309S	S30908	...	...	8	(28) (31) (35) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–8Ni	...	A451	CPF8	J92600	...	...	8	(26) (28)	−425	70	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–10Ni–Cb	Pipe	A312	TP347	S34700	...	...	8	...	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A358	347	S34700	...	...	8	(30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A376	TP347	S34700	...	...	8	(30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A409	TP347	S34700	...	...	8	(30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A312	TP348	S34800	...	...	8	...	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A358	348	S34800	...	...	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A376	TP348	S34800	...	...	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A409	TP348	S34800	...	...	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–12Ni	...	A451	CPH10	J93402	...	...	8	(12) (14) (28) (35) (39)	−325	70	30	20.0	*20.0*	*19.9*	*19.4*
25Cr–12Ni	...	A451	CPH20	J93402	...	...	8	(12) (14) (28) (35) (39)	−325	70	30	20.0	*20.0*	*19.9*	*19.4*
25Cr–20Ni	Pipe	A312	TP310H	S31009	...	...	8	(29) (35) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A451	CPF8C	J92710	...	...	8	(28)	−325	70	30	20.0	*20.0*	*20.0*	*18.6*
18Cr–10Ni–Ti	Smls. pipe	A312	TP321	S32100	...	≤3/8 thk.	8	(28) (30)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A312	TP321	S32100	...	...	8	(28) (30)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A358	321	S32100	...	...	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321	S32100	...	≤3/8 thk.	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A409	TP321	S32100	...	...	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. pipe	A312	TP321H	S32109	...	≤3/8 thk.	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A312	TP321H	S32109	...	...	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. pipe	A358	321H	S32109	...	...	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. pipe	A376	TP321H	S32109	...	≤3/8 thk.	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
16Cr–12Ni–2Mo	Tube	A213	TP316	S31600	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Tube	A269	TP316	S31600	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Tube	A270	TP316	S31600	...	...	8	(14) (26) (28)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Pipe	A312	TP316	S31600	...	...	8	(26) (28)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Pipe	A358	316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Pipe	A376	TP316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																					Type/ Grade	Spec. No.
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)(4a) (Cont'd)																						
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		309S	A358
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		CPF8	A451
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		TP347	A312
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		347	A358
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		TP347	A376
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		TP347	A409
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		TP348	A312
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		348	A358
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		TP348	A376
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		TP348	A409
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		CPH10	A451
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		CPH20	A451
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		TP310H	A312
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		CPF8C	A451
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		TP321	A312
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		TP321	A312
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		321	A358
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		TP321	A376
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		TP321	A409
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		TP321H	A312
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		TP321H	A312
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		321H	A358
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		TP321H	A376
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		TP316	A213
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		TP316	A269
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		TP316	A270
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		TP316	A312
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	A358
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		TP316	A376

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Pipes and Tubes (3)(4a)															
16Cr–12Ni–2Mo	Pipe	A409	TP316	S31600	...	...	8	(26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–13Ni–3Mo	Pipe	A312	TP317	S31700	...	...	8	(26) (28)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–13Ni–3Mo	Pipe	A409	TP317	S31700	...	...	8	(26) (28) (31) (36)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Pipe	A376	TP316H	S31609	...	...	8	(26) (31) (36)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	Pipe	A312	TP316H	S31609	...	...	8	(26)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–10Ni–Cb	Pipe	A376	TP347H	S34709	...	...	8	(30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A312	TP347	S34700	...	...	8	(28)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A358	347	S34700	...	...	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A376	TP347	S34700	...	...	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A409	TP347	S34700	...	...	8	(28) (30) (36)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A312	TP348	S34800	...	...	8	(28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A358	348	S34800	...	...	8	(28) (30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A376	TP348	S34800	...	...	8	(28) (30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A409	TP348	S34800	...	...	8	(28) (30) (36)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A312	TP347H	S34709	...	...	8	...	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	Pipe	A312	TP348H	S34809	...	...	8	...	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–8Ni	Tube	A213	TP304	S30400	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Tube	A269	TP304	S30400	...	...	8	(14) (26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Tube	A270	TP304	S30400	...	...	8	(14) (26) (28)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A312	TP304	S30400	...	...	8	(26) (28)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A358	304	S30400	...	...	8	(26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A376	TP304	S30400	...	...	8	(20) (26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A376	TP304H	S30409	...	...	8	(26) (31) (36)	−325	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A409	TP304	S30400	...	...	8	(26) (28) (31) (36)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	Pipe	A312	TP304H	S30409	...	...	8	(26)	−325	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–12Ni–2Mo	...	A451	CPF8M	J92900	...	...	8	(26) (28)	−425	70	30	20.0	*20.0*	*18.9*	**17.0**
44Fe–25Ni–21Cr–Mo	Tube	A249	...	N08904	...	...	45	...	−325	71	31	20.7	*20.7*	**20.4**	**18.7**
44Fe–25Ni–21Cr–Mo	Pipe	A312	...	N08904	...	...	45	...	−325	71	31	20.7	*20.7*	**20.4**	**18.7**
20Cr–Cu	Tube	A268	TP443	S44300	...	...	a	(7) (35)	−20	70	40	23.3	23.3	23.3	23.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
																				Stainless Steel — Pipes and Tubes (3)(4a)	(Cont'd)
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	TP316	A409
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	TP317	A312
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	TP317	A409
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	TP316H	A376
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	TP316H	A312
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	TP347H	A376
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	TP347	A312
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	347	A358
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	TP347	A376
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	TP347	A409
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	TP348	A312
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	348	A358
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	TP348	A376
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	TP348	A409
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	TP347H	A312
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	TP348H	A312
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	TP304	A213
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	TP304	A269
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	TP304	A270
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	TP304	A312
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	A358
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	TP304	A376
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	TP304H	A376
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	TP304	A409
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	TP304H	A312
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	CPF8M	A451
17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A249
17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A312
23.3	23.3	14.6	12.5	10.7	9.2	7.9	5.9	4.0	2.5	...	...	...	...	...	...	...	...	...	...	TP443	A268

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Pipes and Tubes (3)(4a)															
27Cr	Tube	A268	TP446-1	S44600	...	...	10I	(35)	−20	70	40	23.3	23.3	22.5	21.9
12Cr	Wld. pipe	A1053	50	S41003	...	...	7	...	−20	70	50	23.3	23.3	23.3	22.8
25Cr–8Ni–N	...	A451	CPE20N	J92802	...	...	8	(35) (39)	−325	80	40	26.7	26.7	26.7	26.7
23Cr–4Ni–Mo–Cu–N	...	A789	...	S32304	...	...	10H	(25)	−60	87	58	29.0	27.9	26.1	24.7
23Cr–4Ni–Mo–Cu–N	...	A790	...	S32304	...	...	10H	(25)	−60	87	58	29.0	27.9	26.1	24.7
23Cr–4Ni–Mo–Cu–N	Wld. pipe	A928	2304	S32304	...	...	10H	(25)	−60	87	58	29.0	27.9	26.1	24.7
20Cr–18Ni–6Mo	Pipe	A813	...	S31254	...	...	8	...	−325	94	44	29.3	*29.3*	**28.9**	**26.7**
20Cr–18Ni–6Mo	Pipe	A814	...	S31254	...	...	8	...	−325	94	44	29.3	*29.3*	**28.9**	**26.7**
13Cr	...	A426	CPCA15	J91150	...	...	6	(10) (35)	−20	90	65	30.0	...	...	...
20Cr–18Ni–6Mo	Wld. pipe	A358	...	S31254	...	>3/16	8	...	−325	95	45	30.0	*30.0*	**29.6**	**27.3**
20Cr–18Ni–6Mo	Wld pipe	A358	...	S31254	...	≤3/16	8	...	−325	100	45	30.0	*30.0*	**29.6**	**27.3**
22Cr–5Ni–3Mo–N	...	A789	...	S31803	...	...	10H	(25)	−60	90	65	30.0	30.0	28.9	27.8
22Cr–5Ni–3Mo–N	...	A790	...	S31803	...	...	10H	(25)	−60	90	65	30.0	30.0	28.9	27.8
22Cr–5Ni–3Mo–N	Wld pipe	A928	...	S31803	...	...	10H	(25)	−60	90	65	30.0	30.0	28.9	27.8
20Cr–18Ni–6Mo	Tube	A249	...	S31254	...	>3/16 thk.	8	...	−325	95	45	30.0	*30.0*	**29.5**	**27.3**
20Cr–18Ni–6Mo	Tube	A249	...	S31254	...	≤3/16 thk.	8	...	−325	98	45	30.0	*30.0*	**29.5**	**27.3**
20Cr–18Ni–6Mo	Pipe	A312	...	S31254	...	>3/16 thk.	8	...	−325	95	45	30.0	*30.0*	**29.5**	**27.3**
20Cr–18Ni–6Mo	Pipe	A312	...	S31254	...	≤3/16 thk.	8	...	−325	98	45	30.0	*30.0*	**29.5**	**27.3**
26Cr–4Ni–Mo	...	A790	...	S32900	...	...	10H	(25)	−20	90	70	30.0	...	...	...
46Fe–24Ni–21Cr–6Mo–Cu–N	Smls. & wld. pipe	A312	...	N08367	...	>3/16	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A358	...	N08367	...	>3/16	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A813	...	N08367	...	>3/16	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A814	...	N08367	...	>3/16	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Smls. & wld. pipe	A312	...	N08367	...	≤3/16	45	(26)	−325	100	45	30.0	*30.0*	*30.0*	**29.6**
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A358	...	N08367	...	≤3/16	45	(26)	−325	100	45	30.0	*30.0*	*30.0*	**29.6**
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A813	...	N08367	...	≤3/16	45	(26)	−325	100	45	30.0	*30.0*	*30.0*	**29.6**
46Fe–24Ni–21Cr–6Mo–Cu–N	Wld. pipe	A814	...	N08367	...	≤3/16	45	(26)	−325	100	45	30.0	*30.0*	*30.0*	**29.6**
21Cr–5Mn–1½Ni–Cu–N	Tube	A789	...	S32101	...	>3/16	10H	(25)	−20	94	65	31.3	31.3	29.8	28.5
21Cr–5Mn–1½Ni–Cu–N	Pipe	A790	...	S32101	...	>3/16	10H	(25)	−20	94	65	31.3	31.3	29.8	28.5
22Cr–5Ni–3Mo–N	Tube	A789	2205	S32205	...	...	10H	(25)	−60	95	70	31.7	31.7	30.6	29.4
22Cr–5Ni–3Mo–N	Pipe	A790	2205	S32205	...	...	10H	(25)	−60	95	70	31.7	31.7	30.6	29.4
21Cr–5Mn–1½Ni–Cu–N	Tube	A789	...	S32101	...	≤3/16	10H	(25)	−20	101	77	33.7	33.7	32.1	31.0
21Cr–5Mn–1½Ni–Cu–N	Pipe	A790	...	S32101	...	≤3/16	10H	(25)	−20	101	77	33.7	33.7	32.1	31.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																				Type/ Grade	Spec. No.
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)(4a) (Cont'd)																					
21.5	20.9	20.6	20.2	19.7	19.1	18.4	17.5	16.4	15.1	...	...	...	...	...	...	...	...	...	...	TP446-1	A268
22.1	21.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	A1053
26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	...	...	...	...	...	...	...	...	...	...	...	...	CPE20N	A451
22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2304	A928
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.8**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A813
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.8**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A814
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CPCA15	A426
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**22.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A358
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**22.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A358
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A928
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A249
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A249
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A312
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A312
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A312
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A358
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A813
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A814
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A312
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A358
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A813
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A814
28.5	28.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
28.5	28.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2205	A789
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2205	A790
30.9	30.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
30.9	30.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Pipes and Tubes (3)(4a)															
21Cr–3½Ni–1¾Mo–N	...	A789	...	S32003	...	>0.187 thk.	10H	(25)	−60	95	65	31.7	30.7	28.9	28.6
21Cr–3½Ni–1¾Mo–N	...	A790	...	S32003	...	>0.187 thk.	10H	(25)	−60	95	65	31.7	30.7	28.9	28.6
21Cr–3½Ni–1¾Mo–N	Wld pipe	A928	...	S32003	...	>0.187 thk.	10H	(25)	−60	95	65	31.7	30.7	28.9	28.6
22Cr–5Ni–3Mo–N	Wld pipe	A928	2205	S32205	...	...	10H	(25)	−60	95	65	31.7	31.7	30.6	29.4
24Cr–4Ni–3Mn–1.5Mo–N	Smls. & wld. tube	A789	...	S82441	...	≥0.40 thk.	10H	(25)	−60	99	70	32.9	32.9	32.9	32.9
24Cr–4Ni–3Mn–1.5Mo–N	Smls. & wld. pipe	A790	...	S82441	...	≥0.40 thk.	10H	(25)	−60	99	70	32.9	32.9	32.9	32.9
21Cr–3½Ni–1¾Mo–N	...	A789	...	S32003	...	≤0.187 thk.	10H	(25)	−60	100	70	33.3	32.3	30.4	30.1
21Cr–3½Ni–1¾Mo–N	...	A790	...	S32003	...	≤0.187 thk.	10H	(25)	−60	100	70	33.3	32.3	30.4	30.1
21Cr–3½Ni–1¾Mo–N	Wld. pipe	A928	...	S32003	...	≤0.187 thk.	10H	(25)	−60	100	70	33.3	32.3	30.4	30.1
24Cr–4Ni–3Mn–1.5Mo–N	Smls. & wld. tube	A789	...	S82441	...	<0.40 thk.	10H	(25)	−60	107	78	35.8	35.8	35.8	35.8
24Cr–4Ni–3Mn–1.5Mo–N	Smls. & wld. pipe	A790	...	S82441	...	<0.40 thk.	10H	(25)	−60	107	78	35.8	35.8	35.8	35.8
25Cr–8Ni–3Mo–W–Cu–N	...	A789	...	S32760	...	...	10H	(25)	−60	109	80	36.3	35.9	34.4	34.0
25Cr–8Ni–3Mo–W–Cu–N	...	A790	...	S32760	...	...	10H	(25)	−60	109	80	36.3	35.9	34.4	34.0
29Cr–6.5Ni–2Mo–N	Tube	A789	...	S32906	...	≥0.40 thk.	10H	(25)	−60	109	80	36.3	36.3	34.0	33.5
29Cr–6.5Ni–2Mo–N	Pipe	A790	...	S32906	...	≥0.40 thk.	10H	(25)	−60	109	80	36.3	36.3	34.0	33.5
24Cr–17Ni–6Mn–4½Mo–N	...	A358	...	S34565	...	...	8	(36)	−325	115	60	38.3	*38.1*	*35.8*	*34.5*
25Cr–7Ni–4Mo–N	Smls. & wld. tube	A789	...	S32750	...	...	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
25Cr–7Ni–4Mo–N	Smls. & wld. pipe	A790	2507	S32750	...	...	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
25Cr–7Ni–4Mo–N	Wld. pipe	A928	2507	S32750	...	...	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
29Cr–6.5Ni–2Mo–N	Tube	A789	...	S32906	...	<0.40 thk.	10H	(25)	−60	116	94	38.7	38.6	36.8	35.6
29Cr–6.5Ni–2Mo–N	Pipe	A790	...	S32906	...	<0.40 thk.	10H	(25)	−60	116	94	38.7	38.6	36.8	35.6
Stainless Steel — Plates and Sheets (3)(4a)															
18Cr–11Ni	...	A240	305	S30500	...	...	8	(26) (36) (39)	−325	70	25	16.7	...	...	...
12Cr–Al	...	A240	405	S40500	...	...	7	(35)	−20	60	25	16.7	15.3	14.8	14.5
18Cr–8Ni	...	A240	304L	S30403	...	...	8	(36)	−425	70	25	16.7	*16.7*	*16.7*	**15.8**
16Cr–12Ni–2Mo	...	A240	316L	S31603	...	...	8	(36)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																					
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	Type/ Grade	Spec. No.
Stainless Steel — Pipes and Tubes (3)(4a) (Cont'd)																					
28.6	28.6	28.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
28.6	28.6	28.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
28.6	28.6	28.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A928
28.7	28.4	28.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2205	A928
32.9	32.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
32.9	32.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
30.1	30.1	30.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
30.1	30.1	30.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
30.1	30.1	30.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A928
35.8	35.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
35.8	35.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
34.0	34.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
34.0	34.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
33.0	33.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
33.0	33.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
33.8	*33.2*	*33.1*	*32.7*	*32.4*	*32.0*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A358
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2507	A790
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2507	A928
35.2	35.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A789
35.2	35.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A790
Stainless Steel — Plates and Sheets (3)(4a)																					
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	305	A240
14.3	14.0	13.8	13.5	13.1	12.6	12.0	11.3	8.4	4.0	...	...	...	...	...	...	...	...	...	...	405	A240
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	A240
14.8	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**10.8**	*10.2*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0	316L	A240

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Plates and Sheets (3)(4a)															
18Cr–8Ni	...	A240	302	S30200	...	...	8	(26) (36)	–325	75	30	20.0	*20.0*	*20.0*	**18.6**
12Cr–1Ni	...	A1010	40	S41003	...	...	7	...	–20	66	40	22.0	22.0	22.0	21.5
12Cr–1Ni	...	A1010	50	S41003	...	...	7	...	–20	70	50	23.3	23.3	23.3	22.8
13Cr	...	A240	410S	S41008	...	...	7	(35) (50)	–20	60	30	20.0	18.4	17.8	17.4
13Cr	...	A240	410	S41000	...	...	6	(35)	–20	65	30	20.0	18.4	17.8	17.4
15Cr	...	A240	429	S42900	...	...	6	(35)	–20	65	30	20.0	18.4	17.8	17.4
17Cr	...	A240	430	S43000	...	...	7	(35)	–20	65	30	20.0	18.4	17.8	17.4
18Cr–13Ni–3Mo	...	A240	317L	S31703	...	...	8	(36)	–325	75	30	20.0	*20.0*	*20.0*	**18.9**
25Cr–20Ni	...	A240	310S	S31008	...	...	8	(28) (31) (35) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Plate, sheet, strip	A240	321	S32100	...	...	8	(28) (31) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
23Cr–12Ni	...	A240	309S	S30908	...	...	8	(28) (35) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A240	347	S34700	...	...	8	(36)	–425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A240	348	S34800	...	...	8	(36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	...	A240	310H	S31009	...	...	8	(29) (35) (39)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Plate, sheet, strip	A240	321	S32100	...	...	8	(28) (30) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Plate, sheet, strip	A240	321H	S32109	...	...	8	(30) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
16Cr–12Ni–2Mo	...	A240	316	S31600	...	...	8	(26) (28) (36)	–425	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–13Ni–3Mo	...	A240	317	S31700	...	...	8	(26) (28) (36)	–325	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–10Ni–Cb	...	A240	347	S34700	...	...	8	(28) (36)	–425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A240	348	S34800	...	...	8	(28) (36)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–8Ni	...	A240	304	S30400	...	...	8	(26) (28) (36)	–425	75	30	20.0	*20.0*	*20.0*	**18.6**
44Fe–25Ni–21Cr–Mo	...	A240	904L	N08904	...	...	45	...	–325	71	31	20.7	*20.7*	**20.4**	**18.7**
23Cr–4Ni–Mo–Cu–N	...	A240	2304	S32304	...	...	10H	(25)	–60	87	58	29.0	27.9	26.1	24.7
22Cr–5Ni–3Mo–N	...	A240	...	S31803	...	...	10H	(25)	–60	90	65	30.0	30.0	28.9	27.8
16Cr–4Ni–6Mn	...	A240	201LN	S20153	...	...	8	...	–325	95	45	30.0	*27.6*	*24.7*	*23.4*
20Cr–18Ni–6Mo	...	A240	...	S31254	...	>$^3/_{16}$ thk.	8	...	–325	95	45	30.0	*30.0*	**29.6**	**27.4**
20Cr–18Ni–6Mo	...	A240	...	S31254	...	≤$^3/_{16}$ thk.	8	...	–325	98	45	30.0	*30.0*	**29.6**	**27.4**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
																				Stainless Steel — Plates and Sheets (3)(4a)	(Cont'd)
17.5	**16.6**	**16.2**	**15.8**	**15.5**	**15.2**	**14.9**	**14.6**	**14.3**	*14.0*	...	...	...	...	...	...	...	...	...	...	302	A240
20.8	20.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	A1010
22.1	21.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	A1010
17.2	16.8	16.6	16.2	15.7	15.1	14.4	12.3	8.8	6.4	4.4	2.9	1.8	1.0	...	...	...	...	...	...	410S	A240
17.2	16.8	16.6	16.2	15.7	15.1	14.4	12.3	8.8	6.4	4.4	2.9	1.8	1.0	...	...	...	...	...	...	410	A240
17.2	16.8	16.6	16.2	15.7	15.1	14.4	12.0	9.2	6.5	4.5	3.2	2.4	1.8	...	...	...	...	...	...	429	A240
17.2	16.8	16.6	16.2	15.7	15.1	14.4	12.0	9.2	6.5	4.5	3.2	2.4	1.8	...	...	...	...	...	...	430	A240
17.7	**16.9**	**16.5**	**16.2**	**15.8**	**15.5**	**15.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	317L	A240
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	310H	A240
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	321	A240
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	309S	A240
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	347	A240
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	348	A240
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	310H	A240
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	321	A240
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	321H	A240
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	A240
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	317	A240
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	347	A240
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	348	A240
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	A240
17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	904L	A240
22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2304	A240
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
23.0	*22.9*	*22.8*	*22.6*	*22.3*	*21.8*	*21.5*	...	...	...	...	...	...	...	...	...	...	...	...	...	201LN	A240
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Plates and Sheets (3)(4a)															
46Fe–24Ni–21Cr–6Mo–Cu–N	Plate	A240	...	N08367	...	>3/16	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Sheet & strip	A240	...	N08367	...	≤3/16	45	(26)	−325	100	45	30.0	*30.0*	*30.0*	**29.6**
21Cr–5Mn–1½Ni–Cu–N	...	A240	...	S32101	...	>3/16 thk.	10H	(25)	−20	94	65	31.3	31.3	29.8	28.5
24Cr–4Ni–3Mn–1.5Mo–N	...	A240	...	S82441	...	≥0.40 thk.	10H	(25)	−60	99	70	32.9	32.9	32.9	32.9
21Cr–5Mn–1½Ni–Cu–N	...	A240	...	S32101	...	≤3/16 thk.	10H	(25)	−20	101	77	33.7	33.7	32.1	31.0
22Cr–5Ni–3Mo–N	...	A240	2205	S32205	...	...	10H	(25)	−60	95	65	31.7	31.7	30.6	29.4
21Cr–3½Ni–1¾Mo–N	...	A240	...	S32003	...	>0.187 thk.	10H	(25)	−60	95	65	31.7	30.7	28.9	28.6
21Cr–3½Ni–1¾Mo–N	...	A240	...	S32003	...	≤0.187 thk.	10H	(25)	−60	100	70	33.3	32.3	30.4	30.1
24Cr–4Ni–3Mn–1.5Mo–N	...	A240	...	S82441	...	<0.40 thk.	10H	(25)	−60	107	78	35.8	35.8	35.8	35.8
29Cr–6.5Ni–2Mo–N	...	A240	...	S32906	...	≥0.40 thk.	10H	(25)	−60	109	80	36.3	36.3	34.5	33.5
29Cr–6.5Ni–2Mo–N	...	A240	...	S32906	...	<0.40 thk.	10H	(25)	−60	116	94	38.7	38.6	36.8	35.6
25Cr–8Ni–3Mo–W–Cu–N	...	A240	...	S32760	...	...	10H	(25)	−60	109	80	36.3	36.3	34.8	34.0
25Cr–7Ni–4Mo–N	...	A240	2507	S32750	...	...	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
Stainless Steel — Forgings and Fittings (3)(4a)															
18Cr–13Ni–3Mo	...	A182	F317L	S31703	...	≤5 thk.	8	(9) (21a)	−325	70	25	16.7	*16.7*	**16.7**	**15.7**
18Cr–8Ni	...	A182	F304L	S30403	...	...	8	(9) (21a)	−425	70	25	16.7	*16.7*	*16.7*	*15.8*
18Cr–8Ni	...	A403	WP304L	S30403	...	...	8	(32) (37)	−425	70	25	16.7	*16.7*	*16.7*	*15.8*
16Cr–12Ni–2Mo	...	A182	F316L	S31603	...	...	8	(9) (21a)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
16Cr–12Ni–2Mo	...	A403	WP316L	S31603	...	...	8	(32) (37)	−425	70	25	16.7	*16.7*	*16.7*	**15.7**
18Cr–13Ni–3Mo	...	A403	WP317L	S31703	...	...	8	(32) (37)	−325	75	30	20.0	*20.0*	*20.0*	**18.9**
25Cr–20Ni	...	A182	F310	S31000	...	...	8	(9) (35) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	...	A403	WP310S	S31008	...	...	8	(28) (32) (35) (37)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321	S32100	...	>3/8 thk.	8	(28)	−325	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Forgings	A182	F321	S32100	...	...	8	(9) (21) (28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321	S32100	...	≤3/8 thk.	8	(28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. fittings	A403	WP321	S32100	...	...	8	(28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
Stainless Steel — Plates and Sheets (3)(4a) (Cont'd)																					
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
28.5	28.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
32.9	32.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
30.9	30.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2205	A240
28.6	28.6	28.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
30.1	30.1	30.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
35.8	35.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
33.0	33.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
35.2	35.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
33.9	33.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A240
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2507	A240
Stainless Steel — Forgings and Fittings (3)(4a)																					
14.8	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	F317L	A182
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	F304L	A182
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	WP304L	A403
14.8	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**10.8**	*10.2*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0	F316L	A182
14.8	**14.0**	**13.7**	**13.5**	**13.2**	**12.9**	**12.7**	**12.4**	**12.1**	**11.8**	**10.8**	*10.2*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0	WP316L	A403
17.7	**16.9**	**16.5**	**16.2**	**15.8**	**15.5**	**15.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	WP317L	A403
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	F310	A182
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	WP310S	A403
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	WP321	A403
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	F321	A182
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	WP321	A403
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	WP321	A403

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Forgings and Fittings (3)(4a)															
23Cr–12Ni	...	A403	WP309	S30900	...	...	8	(28) (32) (35) (37) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	...	A182	F310H	S31009	...	...	8	(9) (21) (29) (35) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
25Cr–20Ni	...	A403	WP310H	S31009	...	...	8	(28) (29) (32) (35) (37) (39)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F347	S34700	...	...	8	(9) (21)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A403	WP347	S34700	...	...	8	(32) (37)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F348	S34800	...	...	8	(9) (21)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A403	WP348	S34800	...	...	8	(32) (37)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321	S32100	...	>3/8 thk.	8	(28) (30)	−325	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321H	S32109	...	>3/8 thk.	8	(30)	−325	70	25	16.7	*16.7*	*16.7*	*16.7*
18Cr–10Ni–Ti	Forgings	A182	F321	S32100	...	...	8	(9) (21) (28) (30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Forgings	A182	F321H	S32109	...	...	8	(9) (21)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321	S32100	...	≤3/8 thk.	8	(28) (30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Smls. fittings	A403	WP321H	S32109	...	≤3/8 thk.	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. fittings	A403	WP321	S32100	...	...	8	(28) (30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Wld. fittings	A403	WP321H	S32109	...	...	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
16Cr–12Ni–2Mo	...	A403	WP316H	S31609	...	...	8	(26) (32) (37)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	...	A182	F316H	S31609	...	...	8	(9) (21) (26)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–10Ni–Cb	...	A403	WP347H	S34709	...	...	8	(32) (37)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F347	S34700	...	...	8	(9) (21) (28)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A403	WP347	S34700	...	...	8	(28) (32) (37)	−425	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F348	S34800	...	...	8	(9) (21) (28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A403	WP348	S34800	...	...	8	(28) (32) (37)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F347H	S34709	...	...	8	(9) (21)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A182	F348H	S34809	...	...	8	(9) (21)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
16Cr–12Ni–2Mo	...	A182	F316	S31600	...	...	8	(9) (21) (26) (28)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	...	A403	WP316	S31600	...	...	8	(26) (28) (32) (37)	−425	75	30	20.0	*20.0*	*20.0*	**19.3**
18Cr–13Ni–3Mo	...	A403	WP317	S31700	...	...	8	(26) (28) (32)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
Stainless Steel — Forgings and Fittings (3)(4a) (Cont'd)																					
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	WP309	A403
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	F310H	A182
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	WP310H	A403
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	F347	A182
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	WP347	A403
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	F348	A182
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	WP348	A403
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	WP321	A403
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	WP321H	A403
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	F321	A182
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	F321H	A182
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	WP321	A403
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	WP321H	A403
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	WP321	A403
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	WP321H	A403
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	WP316H	A403
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	F316H	A182
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	WP347H	A403
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	F347	A182
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	WP347	A403
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	F348	A182
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	WP348	A403
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	F347H	A182
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	F348H	A182
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	F316	A182
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	WP316	A403
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	WP317	A403

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Forgings and Fittings (3)(4a)															
18Cr–8Ni	...	A182	F304	S30400	...	...	8	(9) (21) (26) (28)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	...	A403	WP304	S30400	...	...	8	(26) (28) (32) (37)	−425	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	...	A403	WP304H	S30409	...	...	8	(26) (32) (37)	−325	75	30	20.0	*20.0*	*20.0*	**18.6**
18Cr–8Ni	...	A182	F304H	S30409	...	...	8	(9) (21) (26)	−325	75	30	20.0	*20.0*	*20.0*	**18.6**
44Fe–25Ni–21Cr–Mo	...	A182	F904L	N08904	...	...	45	...	−325	71	31	20.7	*20.7*	**20.4**	**18.7**
13Cr	...	A182	F6a	S41000	1	...	6	(35)	−20	70	40	23.3	23.3	22.9	22.5
13Cr	...	A182	F6a	S41000	2	...	6	(35)	−20	85	55	28.3	28.3	27.8	27.3
20Cr–18Ni–6Mo	...	A182	F44	S31254	...	...	8	...	−325	94	44	29.3	*29.3*	**28.9**	**26.7**
20Cr–18Ni–6Mo	...	A403	WPS31254	S31254	...	...	8	...	−325	94	44	29.3	*29.3*	**28.9**	**26.7**
23Cr–4Ni–Mo–Cu–N	...	A182	F68	S32304	...	...	10H	(25)	−60	87	58	29.0	27.9	26.1	24.7
22Cr–5Ni–3Mo–N	...	A182	F51	S31803	...	...	10H	(25)	−60	90	65	30.0	30.0	28.9	27.8
22Cr–5Ni–3Mo–N	...	A815	WPS31803	S31803	...	...	10H	(25)	−60	90	65	30.0	30.0	28.9	27.8
46Fe–24Ni–21Cr–6Mo–Cu–N	Forgings	A182	F62	N08367	...	...	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
46Fe–24Ni–21Cr–6Mo–Cu–N	Fittings	A403	WP6XN	N08367	...	...	45	(26)	−325	95	45	30.0	*30.0*	*29.9*	*28.6*
21Cr–5Mn–1½Ni–Cu–N	...	A815	WP32101	S32101	...	...	10H	(25)	−20	94	65	31.3	31.3	29.8	28.5
22Cr–5Ni–3Mo–N	...	A182	F60	S32205	...	...	10H	(25)	−60	95	65	31.7	31.7	30.6	29.4
22Cr–5Ni–3Mo–N	...	A815	WPS32205	S32205	...	...	10H	(25)	−60	95	65	31.7	31.7	30.6	29.4
25Cr–8Ni–3Mo–W–Cu–N	...	A182	F55	S32760	...	...	10H	(25)	−60	109	80	36.3	36.3	34.8	34.0
25Cr–8Ni–3Mo–W–Cu–N	...	A815	WPS32760	S32760	...	...	10H	(25)	−60	109	80	36.3	36.3	34.8	34.0
25Cr–7Ni–4Mo–N	Forgings	A182	F53	S32750	...	≤2	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
25Cr–7Ni–4Mo–N	Fittings	A815	WPS32750	S32750	...	...	10H	(25)	−60	116	80	38.7	38.5	36.4	35.1
Stainless Steel — Bar (3)(4a)															
18Cr–8Ni	...	A479	304	S30400	...	...	8	(26) (28)	−425	75	30	20.0	20.0	20.0	18.6
18Cr–8Ni	...	A479	304H	S30409	...	...	8	(26)	−325	75	30	20.0	*20.0*	*20.0*	**18.7**
18Cr–8Ni	...	A479	304L	S30403	...	...	8	...	−425	70	25	16.7	*16.7*	*16.7*	*15.8*
16Cr–12Ni–2Mo	...	A479	316	S31600	...	...	8	(26) (28)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	...	A479	316H	S31609	...	...	8	(26)	−325	75	30	20.0	*20.0*	*20.0*	**19.3**
16Cr–12Ni–2Mo	...	A479	316L	S31603	...	...	8	...	−425	70	25	16.7	*16.7*	*16.7*	**15.5**
18Cr–10Ni–Ti	Bar	A479	321	S32100	...	...	8	(28)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Bar	A479	321	S32100	...	...	8	(28) (30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Ti	Bar	A479	321H	S32109	...	...	8	(30)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*
18Cr–10Ni–Cb	...	A479	347	S34700	...	...	8	...	−425	75	30	20.0	20.0	20.0	20.0
18Cr–10Ni–Cb	...	A479	347	S34700	...	...	8	(28) (30)	−425	75	30	20.0	20.0	20.0	20.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
																				Stainless Steel — Forgings and Fittings (3)(4a)	(Cont'd)
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	F304	A182
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	WP304	A403
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	WP304H	A403
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	F304H	A182
17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F904L	A182
22.1	21.6	21.2	20.6	20.0	19.2	17.2	12.3	8.8	6.4	...	...	...	...	...	...	...	...	...	...	F6a Cl. 1	A182
26.9	26.2	25.7	25.1	24.3	23.3	17.2	12.3	8.8	6.4	4.4	2.9	1.8	1.0	...	...	...	...	...	...	F6a Cl. 2	A182
25.2	**24.1**	**23.8**	**23.6**	**23.4**	**23.2**	**23.0**	...	...	...	...	...	...	...	...	...	...	...	...	...	F44	A182
25.2	**24.1**	**23.8**	**23.6**	**23.4**	**23.2**	**23.0**	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS31254	A403
22.9	19.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F68	A182
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F51	A182
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS31803	A815
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F62	A182
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WP6XN	A403
28.5	28.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS32101	A815
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F60	A182
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS32205	A815
33.9	33.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F55	A182
33.9	33.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS32760	A815
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F53	A182
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	WPS32750	A815
																				Stainless Steel — Bar (3)(4a)	
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	A479
17.5	**16.4**	**16.2**	**16.0**	**15.6**	**15.2**	**14.9**	**14.6**	**14.4**	*13.8*	*12.2*	9.7	7.7	6.0	4.7	3.7	2.9	2.3	1.8	1.4	304H	A479
14.8	*14.0*	**13.7**	**13.5**	**13.3**	**13.0**	**12.8**	*11.9*	*9.9*	7.8	6.3	5.1	4.0	3.2	2.6	2.1	1.7	1.1	1.0	0.9	304L	A479
17.9	**17.0**	**16.7**	**16.3**	**16.1**	**15.9**	**15.7**	**15.5**	**15.4**	**15.3**	*14.5*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3	316	A479
17.9	**17.0**	**16.7**	**16.3**	**16.1**	**15.9**	**15.7**	**15.5**	**15.4**	**15.3**	*14.5*	*12.4*	9.8	7.4	5.5	4.1	3.1	2.3	1.7	1.3	316H	A479
14.4	**13.5**	**13.2**	**12.9**	**12.6**	**12.4**	**12.1**	**11.8**	**11.5**	**11.2**	**10.8**	*10.2*	*8.8*	6.4	4.7	3.5	2.5	1.8	1.3	1.0	316L	A479
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	321	A479
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	321	A479
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	321H	A479
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	347	A479
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	347	A479

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Bar (3)(4a)															
18Cr–10Ni–Cb	...	A479	347H	S34709	...	...	8	...	–325	75	30	20.0	20.0	20.0	20.0
44Fe–25Ni–21Cr–Mo	...	A479	904L	N08904	...	...	45	...	–325	71	31	20.7	*20.7*	**20.4**	**18.7**
22Cr–5Ni–3Mo–N	...	A479	...	S31803	...	...	10H	(25)	–60	90	65	30.0	30.0	28.9	27.8
20Cr–18Ni–6Mo	...	A479	...	S31254	...	...	8	...	–325	95	45	30.0	*30.0*	**29.5**	**27.3**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	A479	...	N08367	...	...	45	(26)	–325	95	45	30.0	*30.0*	*29.9*	*28.6*
21Cr–5Mn–1.5Ni–Cu–N	...	A479	...	S32101	...	...	10H	(25)	–20	94	65	31.3	31.3	29.8	28.5
22Cr–5Ni–3Mo–N	...	A479	...	S32205	...	...	10H	(25)	–60	95	65	31.7	31.7	30.6	29.4
24Cr–4Ni–3Mn–1.5Mo–N	...	A479	...	S82441	...	≥$^{7}/_{16}$ thk.	10H	(25)	–60	99	70	32.9	32.9	32.9	32.9
22Cr–13Ni–5Mn	...	A479	XM-19	S20910	Annealed	...	8	...	–325	100	55	33.3	*33.1*	*31.4*	*30.4*
24Cr–4Ni–3Mn–1.5Mo–N	...	A479	...	S82441	...	<$^{7}/_{16}$ thk.	10H	(25)	–60	107	78	35.8	35.8	35.8	35.8
29Cr–6.5Ni–2Mo–N	...	A479	...	S32906	...	...	10H	(25)	–60	109	80	36.3	36.3	34.5	33.5
25Cr–7Ni–4Mo–N	...	A479	...	S32750	...	≤2 thk.	10H	(25)	–60	116	80	38.7	38.5	36.4	35.1
Stainless Steel — Castings (3)(4a)															
29Ni–20Cr–3Cu–2Mo	...	A351	CN7M	N08007	...	...	45	(9) (30)	–325	62	25	16.7	...	...	...
35Ni–15Cr–$^{1}/_{2}$Mo	...	A351	HT30	N08603	...	...	45	(36) (39)	–325	65	28	18.7	...	...	...
25Cr–12Ni	...	A351	CH8	J93400	...	...	8	(9) (31)	–325	65	28	18.7	*18.7*	*18.5*	*18.0*
25Cr–20Ni	...	A351	CK20	J94202	...	...	8	(9) (27) (31) (35) (39)	–325	65	28	18.7	*18.7*	*18.5*	*18.0*
16Cr–14Ni–2Mo	...	A351	CF10MC	...	...	...	8	(30)	–325	70	30	20.0	...	...	...
18Cr–8Ni	...	A351	CF3	J92500	...	...	8	(9)	–425	70	30	20.0	*20.0*	**20.0**	**18.6**
18Cr–12Ni–2Mo	...	A351	CF3M	J92800	...	...	8	(9)	–425	70	30	20.0	*20.0*	20.0	19.2
18Cr–8Ni	...	A351	CF8	J92600	...	...	8	(9) (26) (27) (31)	–425	70	30	20.0	*20.0*	**20.0**	**18.6**
25Cr–12Ni	...	A351	CH10	J93401	...	...	8	(27) (31) (35)	–325	70	30	20.0	*20.0*	*19.9*	*19.4*
25Cr–12Ni	...	A351	CH20	J93402	...	...	8	(9) (27) (31) (35) (39)	–325	70	30	20.0	*20.0*	*19.9*	*19.4*
18Cr–10Ni–Cb	...	A351	CF8C	J92710	...	...	8	(9) (28)	–325	70	30	20.0	*20.0*	*20.0*	*19.5*
18Cr–12Ni–2Mo	...	A351	CF8M	J92900	...	...	8	(9) (26) (27) (30)	–425	70	30	20.0	*20.0*	*20.0*	**18.6**
25Cr–20Ni–$^{1}/_{2}$Mo	...	A351	HK40	J94204	...	...	8	(35) (36) (39)	–325	62	35	20.7	...	...	...
25Cr–20Ni–$^{1}/_{2}$Mo	...	A351	HK30	J94203	...	...	8	(35) (39)	–325	65	35	21.7	...	...	...
18Cr–8Ni	...	A351	CF3A	J92500	...	...	8	(9) (56)	–425	77	35	23.3	23.3	22.7	21.7

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	Type/ Grade	Spec. No.
																				Stainless Steel — Bar (3)(4a)	(Cont'd)
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	347H	A479
17.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	904L	A479
27.2	26.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
25.8	**24.7**	**24.3**	**24.1**	**23.9**	**23.7**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
27.7	**26.2**	**25.7**	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
28.5	28.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
28.7	28.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
32.9	32.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
29.7	29.2	*29.0*	*28.8*	*28.6*	*28.3*	*27.9*	*27.5*	*27.0*	*26.3*	*25.5*	20.4	13.0	8.3	...	...	...	...	...	...	XM-19	A479
35.8	35.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
33.0	33.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
34.5	34.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A479
																				Stainless Steel — Castings (3)(4a)	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CN7M	A351
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	HT30	A351
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	CH8	A351
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	CK20	A351
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CF10MC	A351
17.5	**16.6**	**16.2**	**15.8**	**15.5**	**15.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CF3	A351
17.9	17.0	16.6	16.3	16.0	15.8	15.7	...	...	...	...	...	...	...	...	...	...	...	...	...	CF3M	A351
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	CF8	A351
18.9	**18.3**	**17.9**	**17.5**	**17.0**	**16.5**	**15.9**	**15.4**	*14.3*	11.1	8.5	6.5	5.0	3.8	2.9	2.3	1.8	1.3	0.9	0.8	CH10	A351
18.9	**18.3**	**17.9**	**17.5**	**17.0**	**16.5**	**15.9**	**15.4**	*14.3*	11.1	8.5	6.5	5.0	3.8	2.9	2.3	1.8	1.3	0.9	0.8	CH20	A351
18.8	*18.4*	*18.3*	*18.3*	*18.2*	**18.2**	**18.1**	**18.0**	**18.0**	16.0	12.1	9.1	6.1	4.4	3.3	2.2	1.5	1.2	0.9	0.8	CF8C	A351
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	CF8M	A351
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	HK40	A351
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	HK30	A351
20.4	19.3	18.9	18.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CF3A	A351

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]			
										Tensile	Yield	Min. Temp. to 100	200	300	400
Stainless Steel — Castings (3)(4a)															
18Cr–8Ni	...	A351	CF8A	J92600	...	...	8	(9) (26) (56)	−425	77	35	23.3	23.3	22.7	21.7
25Cr–8Ni–N	...	A351	CE20N	J92802	...	...	8	(35) (39)	−325	80	40	26.7	26.7	26.7	26.7
12Cr	...	A217	CA15	J91150	...	...	6	(35)	−20	90	65	30.0	30.0	29.4	28.9
24Cr–10Ni–4Mo–N	...	A995	2A	J93345	...	...	10H	(9)	−60	95	65	31.7	31.6	29.3	28.2
25Cr–8Ni–3Mo–W–Cu–N	...	A995	6A	J93380	...	...	10H	(9) (25)	−60	100	65	33.3	33.2	31.4	30.3
13Cr–4Ni	...	A487	CA6NM	J91540	A	...	6	(9) (35)	−20	110	80	36.7	36.7	35.9	35.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																					
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	Type/ Grade	Spec. No.
																				Stainless Steel — Castings (3)(4a)	(Cont'd)
20.4	19.3	18.9	18.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CF8A	A351
26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	...	...	...	...	...	...	...	...	...	...	...	...	CE20N	A351
28.4	27.7	27.2	26.5	17.5	16.8	14.9	11.0	7.6	5.0	3.3	2.3	1.5	1.0	...	...	...	...	...	...	CA15	A217
28.2	28.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2A	A995
29.8	29.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6A	A995
34.8	33.9	33.3	32.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CA6NM Cl. A	A487

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)(7)	Notes	Min. Temp., °F (6)	Specified Minimum Strength, ksi	
									Tensile	Yield
Copper and Copper Alloy — Pipes and Tubes										
99.95Cu–P	Pipe	B42	C10200	O61	...	31	...	−452	30	9
99.9Cu–P	Pipe	B42	C12000	O61	...	31	...	−452	30	9
99.9Cu–P	Pipe	B42	C12200	O61	...	31	...	−452	30	9
99.95Cu–P	Tube	B75	C10200	O50	...	31	...	−452	30	9
99.95Cu–P	Tube	B75	C10200	O60	...	31	...	−452	30	9
99.9Cu–P	Tube	B75	C12000	O50	...	31	...	−452	30	9
99.9Cu–P	Tube	B75	C12000	O60	...	31	...	−452	30	9
99.9Cu–P	Tube	B75	C12200	O50	...	31	...	−452	30	9
99.9Cu–P	Tube	B75	C12200	O60	...	31	...	−452	30	9
99.9Cu–P	Tube	B68	C12200	O50	...	31	(24)	−452	30	9
99.9Cu–P	Tube	B68	C12200	O60	...	31	(24)	−452	30	9
99.9Cu–P	Tube	B88	C12200	O50	...	31	(24)	−452	30	9
99.9Cu–P	Tube	B88	C12200	O60	...	31	(24)	−452	30	9
99.9Cu–P	Tube	B280	C12200	O60	...	31	(24)	−452	30	9
85Cu–15Zn	Pipe	B43	C23000	O61	...	32	...	−452	40	12
90Cu–10Ni	...	B467	C70600	WO50	>4.5 O.D.	34	(14)	−452	38	13
90Cu–10Ni	...	B467	C70600	WO61	>4.5 O.D.	34	(14)	−452	38	13
90Cu–10Ni	...	B466	C70600	Annealed	...	34	(14)	−452	38	13
90Cu–10Ni	...	B467	C70600	WO50	≤4.5 O.D.	34	(14)	−452	40	15
90Cu–10Ni	...	B467	C70600	WO61	≤4.5 O.D.	34	(14)	−452	40	15
70Cu–30Ni	...	B467	C71500	WO50	>4.5 O.D.	34	(14)	−452	45	15
70Cu–30Ni	...	B467	C71500	WO61	>4.5 O.D.	34	(14)	−452	45	15
80Cu–20Ni	...	B466	C71000	Annealed	≤4.5 O.D.	34	(14)	−452	45	16
99.95Cu–P	Pipe	B42	C10200	H55	NPS 2½ thru 12	31	(14) (34)	−452	36	30
99.9Cu–P	Pipe	B42	C12000	H55	NPS 2½ thru 12	31	(14) (34)	−452	36	30
99.9Cu–P	Pipe	B42	C12200	H55	NPS 2½ thru 12	31	(14) (34)	−452	36	30
99.95Cu–P	Tube	B75	C10200	H58	...	31	(14) (34)	−452	36	30
99.9Cu–P	Tube	B75	C12000	H58	...	31	(14) (34)	−452	36	30
99.9Cu–P	Tube	B75	C12200	H58	...	31	(14) (34)	−452	36	30
99.9Cu–P	Tube	B88	C12200	H58	...	31	(14) (24) (34)	−452	36	30
70Cu–30Ni	...	B466	C71500	O60	...	34	(14)	−452	52	18
70Cu–30Ni	...	B467	C71500	WO50	≤4.5 O.D.	34	(14)	−452	50	20
70Cu–30Ni	...	B467	C71500	WO61	≤4.5 O.D.	34	(14)	−452	50	20
99.95Cu–P	Pipe	B42	C10200	H80	NPS ⅛ thru 2	31	(14) (34)	−452	45	40
99.9Cu–P	Pipe	B42	C12000	H80	NPS ⅛ thru 2	31	(14) (34)	−452	45	40
99.9Cu–P	Pipe	B42	C12200	H80	NPS ⅛ thru 2	31	(14) (34)	−452	45	40

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]														
Min. Temp. to 100	150	200	250	300	350	400	450	500	550	600	650	700	UNS No.	Spec. No.
													Copper and Copper Alloy — Pipes and Tubes	
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C10200	B42
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12000	B42
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B42
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C10200	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C10200	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12000	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12000	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B75
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B68
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B68
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B88
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B88
6.0	5.1	4.9	4.8	4.7	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B280
8.0	7.9	7.9	7.9	7.9	7.0	5.0	2.0	...	...	...	...	...	C23000	B43
8.7	8.4	8.2	8.0	7.8	7.7	7.5	7.4	7.3	7.0	6.0	...	...	C70600	B467
8.7	8.4	8.2	8.0	7.8	7.7	7.5	7.4	7.3	7.0	6.0	...	...	C70600	B467
8.7	8.4	8.2	8.0	7.8	7.7	7.5	7.4	7.3	7.0	6.0	...	...	C70600	B466
10.0	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.0	7.0	6.0	...	...	C70600	B467
10.0	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.0	7.0	6.0	...	...	C70600	B467
10.0	9.6	9.4	9.2	9.0	8.8	8.6	8.4	8.2	8.1	8.0	7.9	7.8	C71500	B467
10.0	9.6	9.4	9.2	9.0	8.8	8.6	8.4	8.2	8.1	8.0	7.9	7.8	C71500	B467
10.7	10.6	10.5	10.4	10.2	10.1	9.9	9.6	9.3	8.9	8.4	7.7	7.0	C71000	B466
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C10200	B42
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C12000	B42
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C12200	B42
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C10200	B75
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C12000	B75
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C12200	B75
12.0	11.6	10.9	10.4	10.0	9.8	9.5	...	...	...	...	...	...	C12200	B88
12.0	11.6	11.3	11.0	10.8	10.6	10.3	10.1	9.9	9.8	9.6	9.5	9.4	C71500	B466
13.3	12.9	12.6	12.3	12.0	11.7	11.5	11.2	11.0	10.8	10.7	10.5	10.4	C71500	B467
13.3	12.9	12.6	12.3	12.0	11.7	11.5	11.2	11.0	10.8	10.7	10.5	10.4	C71500	B467
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C10200	B42
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C12000	B42
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C12200	B42

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)(7)	Notes	Min. Temp., °F (6)	Specified Minimum Strength, ksi	
									Tensile	Yield
Copper and Copper Alloy — Pipes and Tubes										
99.95Cu–P	Tube	B75	C10200	H80	...	31	(14) (34)	−452	45	40
99.9Cu–P	Tube	B75	C12000	H80	...	31	(14) (34)	−452	45	40
99.9Cu–P	Tube	B75	C12200	H80	...	31	(14) (34)	−452	45	40
Copper and Copper Alloy — Plates and Sheets										
99.95Cu–P	...	B152	C10200	O25	...	31	(14) (24)	−452	30	10
99.95Cu–Ag	...	B152	C10400	O25	...	31	(14) (24)	−452	30	10
99.95Cu–Ag	...	B152	C10500	O25	...	31	(14) (24)	−452	30	10
99.95Cu–Ag	...	B152	C10700	O25	...	31	(14) (24)	−452	30	10
99.9Cu–P	...	B152	C12200	O25	...	31	(14) (24)	−452	30	10
99.9Cu–P	...	B152	C12300	O25	...	31	(14) (24)	−452	30	10
90Cu–10Ni	...	B171	C70600	...	≤2.5 thk.	34	(14)	−452	40	15
97Cu–3Si	...	B96	C65500	O61	...	33	...	−452	50	18
70Cu–30Ni	...	B171	C71500	...	≤2.5 thk.	34	(14)	−452	50	20
90Cu–7Al–3Fe	...	B169	C61400	O25	≤2.0 thk.	35	(13)	−452	70	30
90Cu–7Al–3Fe	...	B169	C61400	O60	≤2.0 thk.	35	(13)	−452	70	30
Copper and Copper Alloy — Forgings										
99.9Cu	...	B283	C11000	...	...	31	(14)	−452	33	11
97Cu–3Si	...	B283	C65500	...	...	33	(14)	−452	52	18
60Cu–38Zn–2Pb	...	B283	C37700	...	...	a	(14)	−325	58	23
60Cu–37Zn–2Pb–Sn	...	B283	C48500	...	...	a	(14)	−325	62	24
60Cu–39Zn–Sn	...	B283	C46400	...	...	32	(14)	−425	64	26
59Cu–39Zn–Fe–Sn	...	B283	C67500	...	...	32	(14)	−325	72	34
Copper and Copper Alloy — Castings										
85Cu–5Sn–5Zn–5Pb	...	B62	C83600	...	...	a	(9)	−325	30	14
57Cu–20Zn–12Ni–9Pb–2Sn	...	B584	C97300	...	...	a	...	−325	30	15
64Cu–20Ni–8Zn–4Sn–4Pb	...	B584	C97600	...	...	a	...	−325	40	17
87Cu–8Sn–4Zn–1Pb	...	B584	C92300	...	...	a	...	−325	36	16
88Cu–Sn–Zn–Pb	...	B584	C92200	...	...	a	...	−325	34	16
88Cu–Sn–Zn–Pb	...	B61	C92200	...	...	a	(9)	−325	34	16
88Cu–8Sn–4Zn	...	B584	C90300	...	...	b	...	−325	40	18
88Cu–10Sn–2Zn	...	B584	C90500	...	...	b	...	−325	40	18
58Cu–38Zn–1Sn–1Pb–1Fe	...	B584	C86400	...	...	a	(9)	−325	60	20
66Cu–25Ni–5Sn–2Pb–2Zn	...	B584	C97800	...	...	a	...	−325	50	22

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]														
Min. Temp. to 100	150	200	250	300	350	400	450	500	550	600	650	700	UNS No.	Spec. No.
Copper and Copper Alloy — Pipes and Tubes (Cont'd)														
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C10200	B75
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C12000	B75
15.0	14.5	13.6	13.0	12.6	12.2	4.3	...	...	...	...	...	...	C12200	B75
Copper and Copper Alloy — Plates and Sheets														
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C10200	B152
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C10400	B152
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C10500	B152
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C10700	B152
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C12200	B152
6.7	5.7	5.4	5.3	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C12300	B152
10.0	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.0	7.0	6.0	...	...	C70600	B171
12.0	12.0	11.9	11.9	11.9	10.7	6.8	...	...	...	...	...	...	C65500	B96
13.3	12.9	12.6	12.3	12.0	11.7	11.5	11.2	11.0	10.8	10.7	10.5	10.4	C71500	B171
20.0	19.9	19.8	19.7	19.5	19.4	19.2	19.0	18.8	...	...	...	...	C61400	B169
20.0	19.9	19.8	19.7	19.5	19.4	19.2	19.0	18.8	...	...	...	...	C61400	B169
Copper and Copper Alloy — Forgings														
7.3	6.2	6.0	5.8	5.0	4.0	3.0	2.3	1.7	...	...	...	...	C11000	B283
12.0	12.0	11.9	11.9	11.9	10.7	6.8	...	...	...	...	...	...	C65500	B283
15.3	14.5	13.9	13.3	10.5	7.5	2.0	...	...	...	...	...	...	C37700	B283
16.0	16.0	16.0	16.0	16.0	16.0	16.0	...	...	...	...	...	...	C48500	B283
17.3	17.3	17.3	17.3	17.1	6.3	2.5	...	...	...	...	...	...	C46400	B283
22.7	22.7	22.7	22.7	22.7	22.7	22.7	...	...	...	...	...	...	C67500	B283
Copper and Copper Alloy — Castings														
9.3	9.3	9.2	8.6	8.1	7.7	7.4	7.3	...	...	...	...	...	C83600	B62
10.0	...	...	...	...	...	...	...	...	...	...	...	...	C97300	B584
11.3	10.1	9.5	9.1	8.7	...	...	...	...	...	...	...	...	C97600	B584
10.7	10.7	10.7	10.7	10.7	10.7	10.7	...	...	...	...	...	...	C92300	B584
10.7	9.6	9.5	9.4	9.2	8.9	8.6	...	...	...	...	...	...	C92200	B584
10.7	9.6	9.5	9.4	9.2	8.9	8.6	8.4	8.3	8.3	...	...	...	C92200	B61
12.0	12.0	12.0	12.0	12.0	12.0	12.0	...	...	...	...	...	...	C90300	B584
12.0	12.0	12.0	12.0	12.0	12.0	12.0	...	...	...	...	...	...	C90500	B584
13.3	13.3	13.3	13.3	13.3	13.3	...	...	...	...	...	...	...	C86400	B584
14.7	14.7	14.7	14.7	14.7	14.7	...	...	...	...	...	...	...	C97800	B584

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)(7)	Notes	Min. Temp., °F (6)	Specified Minimum Strength, ksi	
									Tensile	Yield
Copper and Copper Alloy — Castings										
58Cu–39Zn–1Fe–1Al–1Mn	...	B584	C86500	...	...	b	...	−325	65	25
88Cu–9Al–3Fe	...	B148	C95200	...	...	35	(9)	−425	65	25
89Cu–10Al–1Fe	...	B148	C95300	...	...	35	(9)	−425	65	25
90Cu–7Al–3Si	...	B148	C95600	...	...	35	...	−325	60	28
85Cu–11Al–4Fe	...	B148	C95400	...	...	35	...	−325	75	30
58Cu–34Zn–2Fe–2Al–2Mn	...	B584	C86700	...	...	a	...	−325	80	32
82Cu–11Al–4Fe–3Mn	...	B148	C95500	...	...	35	...	−452	90	40
63Cu–27Zn–4Al–3Fe–3Mn	...	B584	C86200	...	...	b	...	−325	90	45
61Cu–27Zn–6Al–3Fe–3Mn	...	B584	C86300	...	...	b	...	−325	110	60
Copper and Copper Alloy — Rod										
75Cu–21.5Zn–3Si	...	B371	C69300	H02	≤½	a	...	−325	85	45
75Cu–21.5Zn–3Si	...	B371	C69300	H02	>½, ≤1	a	...	−325	75	35
75Cu–21.5Zn–3Si	...	B371	C69300	H02	>1, ≤2	a	...	−325	70	30

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]														
Min. Temp. to 100	150	200	250	300	350	400	450	500	550	600	650	700	UNS No.	Spec. No.
Copper and Copper Alloy — Castings (Cont'd)														
16.7	16.7	16.7	16.7	16.7	16.7	...	...	...	...	...	...	...	C86500	B584
16.7	15.7	15.2	14.8	14.5	14.3	14.2	14.1	14.1	11.7	7.4	...	...	C95200	B148
16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	...	...	C95300	B148
18.7	...	...	...	...	...	...	...	...	...	...	...	...	C95600	B148
20.0	19.0	18.7	18.5	18.5	18.5	18.5	16.0	13.9	...	...	...	...	C95400	B148
21.3	21.3	21.3	21.3	21.3	21.3	...	...	...	...	...	...	...	C86700	B584
26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	...	...	...	...	C95500	B148
30.0	30.0	30.0	30.0	30.0	30.0	...	...	...	...	...	...	...	C86200	B584
36.7	36.7	36.7	36.7	36.7	36.7	...	...	...	...	...	...	...	C86300	B584
Copper and Copper Alloy — Rod														
28.3	25.9	25.4	25.4	25.4	...	...	...	...	...	...	...	...	C69300	B371
23.3	20.2	19.8	19.8	19.8	...	...	...	...	...	...	...	...	C69300	B371
20.0	17.3	17.0	17.0	17.0	...	...	...	...	...	...	...	...	C69300	B371

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]							
								Tensile	Yield	Min. Temp. to 100	200	300	400	500	600	650	700
Nickel and Nickel Alloy — Pipes and Tubes (4a)																	
99.0Ni–Low C	B161	N02201	Annealed	>5 O.D.	41	...	−325	50	10	6.7	6.4	6.3	6.3	6.3	6.3	6.2	6.2
99.0Ni–Low C	B725	N02201	Annealed	>5 O.D.	41	...	−325	50	10	6.7	6.4	6.3	6.3	6.3	6.3	6.2	6.2
99.0Ni	B161	N02200	Annealed	>5 O.D.	41	...	−325	55	12	8.0	8.0	8.0	8.0	8.0	8.0	...	...
99.0Ni	B725	N02200	Annealed	>5 O.D.	41	...	−325	55	12	8.0	8.0	8.0	8.0	8.0	8.0	...	...
99.0Ni–Low C	B161	N02201	Annealed	≤5 O.D.	41	...	−325	50	12	8.0	7.7	7.5	7.5	7.5	7.5	7.5	7.4
99.0Ni–Low C	B725	N02201	Annealed	≤5 O.D.	41	...	−325	50	12	8.0	7.7	7.5	7.5	7.5	7.5	7.5	7.4
99.0Ni	B161	N02200	Annealed	≤5 O.D.	41	...	−325	55	15	10.0	10.0	10.0	10.0	10.0	10.0	...	...
99.0Ni	B725	N02200	Annealed	≤5 O.D.	41	...	−325	55	15	10.0	10.0	10.0	10.0	10.0	10.0	...	...
67Ni–30Cu	B165	N04400	Annealed	>5 O.D.	42	...	−325	70	25	16.7	14.6	13.6	13.2	13.1	13.1	13.1	13.0
67Ni–30Cu	B725	N04400	Annealed	>5 O.D.	42	...	−325	70	25	16.7	14.6	13.6	13.2	13.1	13.1	13.1	13.0
33Ni–42Fe–21Cr	B407	N08800	H.F. or H.F. ann.	...	45	...	−325	65	25	16.7	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*
72Ni–15Cr–8Fe	B167	N06600	H.F. or H.F. ann.	>5 O.D.	43	...	−325	75	25	16.7	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*
33Ni–42Fe–21Cr	B407	N08810	C.D. sol. ann. or H.F. ann.	...	45	(62)	−325	65	25	16.7	16.7	16.7	16.7	16.7	16.5	16.1	15.7
33Ni–42Fe–21Cr	B514	N08810	Annealed	...	45	(62)	−325	65	25	16.7	16.7	16.7	16.7	16.7	16.5	16.1	15.7
33Ni–42Fe–21Cr–Al–Ti	B407	N08811	C.D. sol. ann. or H.F. ann.	...	45	(62)	−325	65	25	16.7	16.7	16.7	16.7	16.7	16.5	16.1	15.7
67Ni–30Cu	B165	N04400	Annealed	≤5 O.D.	42	...	−325	70	28	18.7	16.4	15.2	14.7	14.7	14.7	14.7	14.6
67Ni–30Cu	B725	N04400	Annealed	≤5 O.D.	42	...	−325	70	28	18.7	16.4	15.2	14.7	14.7	14.7	14.7	14.6
26Ni–22Cr–5Mo–Ti	B619	N08320	Sol. ann.	...	45	...	−325	75	28	18.7	*18.7*	*18.7*	*18.7*	*18.7*	*18.6*	*18.2*	*17.8*
26Ni–22Cr–5Mo–Ti	B622	N08320	Sol. ann.	...	45	...	−325	75	28	18.7	18.7	*18.7*	*18.7*	*18.7*	*18.6*	*18.2*	*17.8*
99.0Ni–Low C	B161	N02201	Str. rel.	...	41	...	−325	60	30	20.0	20.0	19.8	19.8	19.7	19.0	...	...
99.0Ni–Low C	B725	N02201	Str. rel.	...	41	...	−325	60	30	20.0	20.0	19.8	19.8	19.7	19.0	...	...
33Ni–42Fe–21Cr	B514	N08800	Annealed	...	45	...	−325	75	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
72Ni–15Cr–8Fe	B167	N06600	H.F. or H.F. ann.	≤5 O.D.	43	...	−325	80	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
72Ni–15Cr–8Fe	B167	N06600	C.D. ann.	>5 O.D.	43	...	−325	80	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
33Ni–42Fe–21Cr	B407	N08800	C.D. ann.	...	45	(61)	−325	75	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
31Ni–31Fe–29Cr–Mo	B668	N08028	Sol. ann.	...	45	...	−325	73	31	20.7	*20.7*	*20.7*	*20.7*	*20.7*	**19.5**	**18.9**	**18.3**
99.0Ni	B161	N02200	Str. rel.	...	41	...	−325	65	40	21.7	21.7	21.6	21.6	21.4	20.6	...	...
99.0Ni	B725	N02200	Str. rel.	...	41	...	−325	65	40	21.7	21.7	21.6	21.6	21.4	20.6	...	...
35Ni–35Fe–20Cr–Cb	B464	N08020	Annealed	...	45	...	−325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	23.3	23.3
35Ni–35Fe–20Cr–Cb	B474	N08020	Annealed	...	45	...	−325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	23.3

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																			UNS No.	Spec. No.
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	1,550	1,600	1,650		
Nickel and Nickel Alloy — Pipes and Tubes (4a)																				
6.1	6.0	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B161
6.1	6.0	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B725
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B161
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B725
7.3	7.2	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B161
7.3	7.2	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B725
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B161
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B725
12.9	12.7	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B165
12.9	12.7	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B725
16.7	*16.7*	*16.7*	*16.7*	*16.7*	*16.6*	*16.3*	*13.0*	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B407
16.7	*16.7*	*16.7*	*16.0*	*10.6*	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B167
15.3	*15.0*	*14.7*	*14.5*	*14.2*	*14.0*	*13.8*	*11.6*	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B407
15.3	*15.0*	*14.7*	*14.5*	*14.2*	*14.0*	*13.8*	*11.6*	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B514
15.3	*15.0*	*14.7*	*14.5*	*14.2*	*14.0*	*13.8*	12.9	10.4	8.3	6.7	5.4	4.3	3.4	2.7	2.2	1.6	1.2	0.91	N08811	B407
14.5	14.3	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B165
14.5	14.3	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B725
17.5	*17.2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08320	B619
17.5	*17.2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08320	B622
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02201	B161
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02201	B725
20.0	*20.0*	20.0	20.0	20.0	19.9	17.0	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B514
20.0	*20.0*	*20.0*	*16.0*	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B167
20.0	*20.0*	*20.0*	*16.0*	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B167
20.0	*20.0*	*20.0*	*20.0*	*20.0*	*19.9*	*17.0*	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B407
17.7	**17.2**	**16.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08028	B668
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B161
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B725
23.2	*22.7*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B464
23.2	*22.7*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B474

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]							
								Tensile	Yield	Min. Temp. to 100	200	300	400	500	600	650	700
Nickel and Nickel Alloy — Pipes and Tubes (4a)																	
35Ni–35Fe–20Cr–Cb	B729	N08020	Annealed	...	45	...	−325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	23.3	23.3
42Ni–21.5Cr–3Mo–2.3Cu	B163	N08825	Annealed	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	B423	N08825	C.D. ann.	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	B474	N08825	Annealed	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	B704	N08825	Annealed	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	B705	N08825	...	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
47Ni–22Cr–19Fe–6Mo	B619	N06007	Sol. ann.	...	45	...	−325	90	35	23.3	*23.3*	*23.3*	*23.3*	23.3	**22.7**	**22.4**	**22.2**
47Ni–22Cr–19Fe–6Mo	B622	N06007	Sol. ann.	...	45	...	−325	90	35	23.3	*23.3*	*23.3*	*23.3*	23.3	**22.7**	**22.4**	**22.2**
40Ni–29Cr–15Fe–5Mo	B619	N06030	Sol. ann.	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**	**20.9**	**20.5**
40Ni–29Cr–15Fe–5Mo	B622	N06030	Sol. ann.	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**	**20.9**	**20.5**
40Ni–29Cr–15Fe–5Mo	B626	N06030	Sol. ann.	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**	**20.9**	**20.5**
72Ni–15Cr–8Fe	B167	N06600	C.D. ann.	≤5 O.D.	43	...	−325	80	35	23.3	*23.3*	*23.3*	**23.3**	23.3	*23.3*	*23.3*	*23.3*
72Ni–15Cr–8Fe	B517	N06600	C.D. ann.	...	43	...	−325	80	35	23.3	*23.3*	*23.3*	**23.3**	23.3	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	B163	N06690	C.D. ann.	≤3 O.D.	43	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	B167	N06690	C.D. ann.	≤5 O.D.	43	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
37Ni–33Fe–25Cr	B163	N08120	Sol. ann.	...	45	...	−325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**	**23.3**	**22.9**
37Ni–33Fe–25Cr	B407	N08120	Sol. ann.	...	45	...	−325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**	**23.3**	**22.9**
37Ni–33Fe–25Cr	B514	N08120	Sol. ann.	...	45	...	−325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**	**23.3**	**22.9**
37Ni–33Fe–25Cr	B515	N08120	Sol. ann.	...	45	...	−325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**	**23.3**	**22.9**
61Ni–16Mo–16Cr	B619	N06455	Sol. ann.	...	43	...	−325	100	40	26.7	*26.7*	*26.7*	**26.7**	26.7	*26.7*	*26.7*	*26.5*

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																			UNS No.	Spec. No.
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	1,550	1,600	1,650		
Nickel and Nickel Alloy — Pipes and Tubes (4a) (Cont'd)																				
23.2	*22.7*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B729
23.2	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B163
23.2	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B423
23.2	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B474
23.2	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B704
23.2	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B705
22.0	**21.8**	*21.7*	*20.0*	*19.5*	*18.9*	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B619
22.0	**21.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B622
20.1	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B619
20.1	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B622
20.1	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B626
23.3	*23.3*	*23.3*	16.0	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B167
23.3	*23.3*	*23.3*	16.0	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B517
23.3	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B163
23.3	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B167
22.6	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B163
22.6	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B407
22.6	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B514
22.6	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B515
26.2	*25.8*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06455	B619

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi Tensile	Yield	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)] Min. Temp. to 100	200	300	400	500	600
Nickel and Nickel Alloy — Pipes and Tubes (4a)																	
47Ni–22Cr–9Mo–18Fe	...	B619	...	N06002	Sol. ann.	...	43	...	−325	100	40	26.7	*26.7*	*26.7*	*26.7*	*25.5*	*24.2*
47Ni–22Cr–9Mo–18Fe	...	B622	...	N06002	Sol. ann.	...	43	...	−325	100	40	26.7	*26.7*	*26.7*	*26.7*	*25.5*	*24.2*
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B619	...	N08031	Annealed	...	45	...	−325	94	40	26.7	*26.7*	**26.7**	**24.7**	**23.3**	**22.2**
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B622	...	N08031	Annealed	...	45	...	−325	94	40	26.7	*26.7*	**26.7**	**24.7**	**23.3**	**22.2**
61Ni–16Mo–16Cr	...	B622	...	N06455	Sol. ann.	...	43	...	−325	100	40	26.7	*26.7*	*26.7*	*26.7*	*26.7*	*26.7*
54Ni–16Mo–15Cr	...	B619	...	N10276	Sol. ann.	...	43	...	−325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
54Ni–16Mo–15Cr	...	B622	...	N10276	Sol. ann.	...	43	...	−325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
54Ni–16Mo–15Cr	...	B626	...	N10276	Sol. ann.	...	43	...	−325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
67Ni–30Cu	...	B165	...	N04400	Str. rel.	...	42	(54)	−325	85	55	28.3	28.3	28.3	28.3	28.3	...
67Ni–30Cu	...	B725	...	N04400	Str. rel.	...	42	(54)	−325	85	55	28.3	28.3	28.3	28.3	28.3	...
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B675	...	N08367	Annealed	>3/16	45	...	−325	95	45	30.0	*30.0*	*29.9*	*28.6*	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B690	...	N08367	Annealed	>3/16	45	...	−325	95	45	30.0	*30.0*	*29.9*	*28.6*	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B804	...	N08367	Annealed	>3/16	45	...	−325	95	45	30.0	*30.0*	*29.9*	*28.6*	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B675	...	N08367	Annealed	≤3/16	45	...	−325	100	45	30.0	*30.0*	*30.0*	**29.6**	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B690	...	N08367	Annealed	≤3/16	45	...	−325	100	45	30.0	*30.0*	*30.0*	**29.6**	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B804	...	N08367	Annealed	≤3/16	45	...	−325	100	45	30.0	*30.0*	*29.9*	**28.6**	**27.7**	**26.2**
55Ni–21Cr–13.5Mo	...	B619	...	N06022	Sol. ann.	...	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.0**	**27.6**
55Ni–21Cr–13.5Mo	...	B622	...	N06022	Sol. ann.	...	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.0**	**27.6**
58Ni–33Cr–8Mo	...	B619	...	N06035	Sol. ann.	...	43	...	−325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
58Ni–33Cr–8Mo	...	B622	...	N06035	Sol. ann.	...	43	...	−325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
58Ni–33Cr–8Mo	...	B626	...	N06035	Sol. ann.	...	43	...	−325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
59Ni–23Cr–16Mo	...	B619	...	N06059	Sol. ann.	...	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.7**	**28.2**
59Ni–23Cr–16Mo	...	B622	...	N06059	Sol. ann.	...	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.7**	**28.2**
59Ni–23Cr–16Mo	...	B626	...	N06059	Sol. ann.	All	43	...	−325	100	45	30.0	30.0	30.0	30.0	**29.7**	**28.2**
59Ni–23Cr–16Mo–1.6Cu	...	B619	...	N06200	Sol. ann.	All	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
59Ni–23Cr–16Mo–1.6Cu	...	B622	...	N06200	Sol. ann.	All	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
59Ni–23Cr–16Mo–1.6Cu	...	B626	...	N06200	Sol. ann.	All	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
62Ni–22Mo–15Cr	...	B619	...	N10362	Sol. ann.	All	43	...	−325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–22Mo–15Cr	...	B622	...	N10362	Sol. ann.	All	43	...	−325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–22Mo–15Cr	...	B626	...	N10362	Sol. ann.	All	43	...	−325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–28Mo–5Fe	...	B619	...	N10001	Sol. ann.	...	44	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	*30.0*
62Ni–28Mo–5Fe	...	B622	...	N10001	Sol. ann.	...	44	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	*30.0*
65Ni–28Mo–2Fe	...	B619	...	N10665	Sol. ann.	...	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–28Mo–2Fe	...	B622	...	N10665	Sol. ann.	...	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B619	...	N10675	Sol. ann.	...	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B622	...	N10675	Sol. ann.	...	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B626	...	N10675	Sol. ann.	...	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
60Ni–22Cr–9Mo–3.5Cb	...	B444	1	N06625	Annealed	...	43	(64) (70)	−325	120	60	40.0	*40.0*	*39.6*	*39.2*	*38.6*	*37.8*
60Ni–22Cr–9Mo–3.5Cb	...	B705	1	N06625	Annealed	...	43	(64) (70)	−325	120	60	40.0	*40.0*	*39.6*	*39.2*	*38.6*	*37.8*

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																							
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	1,550	1,600	1,650	UNS No. or Grade	Spec. No.
																					Nickel and Nickel Alloy — Pipes and Tubes (4a)	
23.7	*23.3*	*22.9*	*22.7*	*22.5*	*19.6*	*19.5*	*19.3*	*19.3*	*17.5*	14.1	11.3	9.3	7.7	6.1	4.8	3.8	3.0	...	...	...	N06002	B619
23.7	*23.3*	*22.9*	*22.7*	*22.5*	*19.6*	*19.5*	*19.3*	*19.3*	*17.5*	14.1	11.3	9.3	7.7	6.1	4.8	3.8	3.0	...	...	...	N06002	B622
21.7	**11.1**	**8.9**	**7.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B619
21.7	**11.1**	**8.9**	**7.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B622
26.7	**26.5**	**26.1**	**25.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06455	B622
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B619
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B622
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B626
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B165
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B725
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B675
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B690
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B804
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B675
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B690
25.6	**25.1**	**24.7**	**24.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B804
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B619
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B622
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B619
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B622
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B626
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B619
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B622
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B626
26.2	**25.7**	**25.4**	25.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B619
26.2	**25.7**	**25.4**	25.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B622
26.2	**25.7**	**25.4**	25.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B626
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B619
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B622
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B626
30.0	*30.0*	**30.0**	**29.9**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10001	B619
30.0	*30.0*	**30.0**	**29.9**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10001	B622
34.0	*34.0*	*34.0*	*34.0*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10665	B619
34.0	*34.0*	*34.0*	*34.0*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10665	B622
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B619
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B622
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B626
37.4	*37.0*	36.6	36.3	*36.1*	*35.8*	*35.4*	*31.2*	*31.2*	23.1	21.0	13.2	...	...	...	...	...	...	...	...	...	N06625	B444
37.4	*37.0*	*36.6*	*36.3*	*36.1*	*35.8*	*35.4*	*31.2*	*31.2*	*23.1*	*21.0*	*13.2*	...	...	...	...	...	...	...	...	...	N06625	B705

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi Tensile	Yield	Min. Temp. to 100	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)] 200	300	400	500	600
Nickel and Nickel Alloy — Pipes and Tubes (4a)																	
57Ni–22Cr–14W–2Mo–La	...	B619	...	N06230	Sol. ann.	...	43	...	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
57Ni–22Cr–14W–2Mo–La	...	B622	...	N06230	Sol. ann.	...	43	...	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
57Ni–22Cr–14W–2Mo–La	...	B626	...	N06230	Sol. ann.	...	43	...	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B619	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B622	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B626	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
Nickel and Nickel Alloy — Plates and Sheets (4a)																	
99.0Ni–Low C	Plate	B162	...	N02201	H.R. ann.	...	41	...	–325	50	12	8.0	7.7	7.5	7.5	7.5	7.5
99.0Ni–Low C	Plate	B162	...	N02201	H.R. as R.	...	41	...	–325	50	12	8.0	7.7	7.5	7.5	7.5	7.5
99.0Ni	Plate	B162	...	N02200	H.R. ann.	...	41	...	–325	55	15	10.0	10.0	10.0	10.0	10.0	10.0
99.0Ni	Plate	B162	...	N02200	H.R. as R.	...	41	...	–325	55	20	13.3	13.3	13.3	13.3	13.3	13.3
33Ni–42Fe–21Cr	...	B409	...	N08810	Annealed	All	45	...	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.6
33Ni–42Fe–21Cr–Al–Ti	...	B409	...	N08811	Annealed	All	45	...	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
26Ni–22Cr–5Mo–Ti	...	B620	...	N08320	Sol. ann.	All	45	...	–325	75	28	18.7	*18.7*	*18.7*	*18.7*	*18.7*	*18.6*
67Ni–30Cu	Plate	B127	...	N04400	H.R. ann.	...	42	...	–325	70	28	18.7	16.4	*15.2*	14.7	14.7	14.7
47Ni–22Cr–19Fe–6Mo	...	B582	...	N06007	Sol. ann.	>3/4	45	...	–325	85	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.5**
33Ni–42Fe–21Cr	...	B409	...	N08800	Annealed	All	45	...	–325	75	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
31Ni–31Fe–29Cr–Mo	...	B709	...	N08028	Sol. ann.	...	45	...	–325	73	31	20.7	*20.7*	*20.7*	*20.7*	*20.7*	**19.5**
42Ni–21.5Cr–3Mo–2.3Cu	...	B424	...	N08825	Annealed	...	45	...	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
35Ni–35Fe–20Cr–Cb	...	B463	...	N08020	Annealed	All	45	...	–325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
40Ni–29Cr–15Fe–5Mo	...	B582	...	N06030	Sol. ann.	All	45	...	–325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**
47Ni–22Cr–19Fe–6Mo	...	B582	...	N06007	Sol. ann.	≤3/4	45	...	–325	90	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*22.7*
47Ni–22Cr–9Mo–18Fe	...	B435	...	N06002	H.R. sol. ann.	All	43	...	–325	95	35	23.3	23.3	23.3	23.3	22.3	21.2
72Ni–15Cr–8Fe	Plate	B168	...	N06600	H.R. ann.	...	43	...	–325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
72Ni–15Cr–8Fe	Plate	B168	...	N06600	H.R. as R.	...	43	...	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	Plate	B168	...	N06690	Annealed	≥3/16	43	...	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	Sheet	B168	...	N06690	Annealed	0.018–0.250	43	...	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
67Ni–30Cu	Plate	B127	...	N04400	H.R. as R.	...	42	...	–325	75	40	25.0	25.0	24.7	23.9	23.4	23.1
37Ni–33Fe–25Cr	...	B409	...	N08120	Sol. ann.	All	45	...	–325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B625	...	N08031	Annealed	All	45	...	–325	94	40	26.7	*26.7*	**26.7**	**24.7**	**23.3**	**22.2**
61Ni–16Mo–16Cr	...	B575	...	N06455	Sol. ann.	All	43	...	–325	100	40	26.7	*26.7*	*26.7*	*26.7*	*26.7*	*26.7*
54Ni–16Mo–15Cr	...	B575	...	N10276	Sol. ann.	All	43	...	–325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
60Ni–22Cr–9Mo–3.5Cb	Plate	B443	1	N06625	Annealed	All	43	(64) (70)	–325	110	55	36.7	36.7	36.3	35.9	35.4	34.7
57Ni–22Cr–14W–2Mo–La	...	B435	...	N06230	Sol. ann.	All	43	...	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
55Ni–21Cr–13.5Mo	Sheet	B575	...	N06022	Sol. ann.	<3/16	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.0**	**27.6**
58Ni–33Cr–8Mo	...	B575	...	N06035	Sol. ann.	All	43	...	–325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																						
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	1,550	1,600	1,650	UNS No. or Grade	Spec. No.
																					Nickel and Nickel Alloy — Pipes and Tubes (4a) (Cont'd)	
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B619
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B622
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B626
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B619
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B622
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B626
																					Nickel and Nickel Alloy — Plates and Sheets (4a)	
7.5	7.4	7.4	7.2	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B162
7.5	7.4	7.4	7.2	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B162
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B162
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B162
16.2	15.8	15.5	15.1	14.9	14.6	14.3	14.0	13.8	11.6	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B409
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.7	12.9	10.4	8.3	6.7	5.4	4.3	3.4	2.7	2.2	1.6	1.2	0.91	N08811	B409
18.2	*17.8*	**17.5**	**17.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08320	B620
14.7	14.6	14.5	14.3	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B127
19.2	**19.0**	**18.8**	**18.7**	*18.6*	*18.5*	*18.4*	*18.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B582
20.0	*20.0*	*20.0*	*20.0*	20.0	20.0	20.0	19.9	17.0	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B409
18.9	**18.3**	**17.7**	**17.2**	**16.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08028	B709
23.3	*23.3*	**23.2**	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B424
23.3	*23.3*	*23.2*	22.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B463
20.9	**20.5**	**20.1**	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B582
22.4	*22.2*	*22.0*	*21.8*	*21.7*	*20.0*	*19.5*	*18.9*	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B582
20.7	20.3	20.1	19.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06002	B435
23.3	*23.3*	*23.3*	*23.3*	*23.3*	16.0	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B168
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*16.0*	*10.6*	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B168
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B168
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B168
22.9	22.7	20.0	14.5	8.5	4.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B127
23.3	**22.9**	**22.6**	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B409
21.7	**21.3**	**20.9**	**20.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B625
26.7	**26.5**	**26.1**	**25.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06455	B575
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B575
34.3	33.9	33.6	33.3	33.1	32.8	32.5	31.2	31.2	23.1	21.0	13.2	...	...	...	...	...	...	...	...	...	N06625	B443
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B435
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B575
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B575

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi Tensile	Yield	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)] Min. Temp. to 100	200	300	400	500	600
Nickel and Nickel Alloy — Plates and Sheets (4a)																	
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B688	...	N08367	Annealed	>3/16	45	...	–325	95	45	30.0	*30.0*	*29.9*	28.6	**27.7**	**26.2**
46Fe–24Ni–21Cr–6Mo–Cu–N	...	B688	...	N08367	Annealed	≤3/16	45	...	–325	100	45	30.0	*30.0*	*30.0*	**29.6**	**27.7**	**26.2**
59Ni–23Cr–16Mo	...	B575	...	N06059	Sol. ann.	All	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	29.6	28.1
59Ni–23Cr–16Mo–1.6Cu	...	B575	...	N06200	Sol. ann.	All	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
62Ni–22Mo–15Cr	...	B575	...	N10362	Sol. ann.	All	43	...	–325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–28Mo–5Fe	Plate	B333	...	N10001	Sol. ann.	≥3/16, ≤2 1/2	44	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	*30.0*
62Ni–28Mo–5Fe	Sheet	B333	...	N10001	Sol. ann.	<3/16	44	...	–325	115	50	33.3	*33.3*	*33.3*	*33.3*	*33.3*	*33.3*
65Ni–28Mo–2Fe	...	B333	...	N10665	Sol. ann.	All	44	...	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B333	...	N10675	Sol. ann.	All	44	...	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B625	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
Nickel and Nickel Alloy — Forgings and Fittings (4a)																	
99.0Ni–Low C	...	B160	...	N02201	Annealed	All	41	(9) (9a)	–325	50	10	6.7	6.4	6.3	6.3	6.3	6.3
99.0Ni–Low C	...	B366	...	N02201	Annealed	All	41	(32) (74)	–325	50	10	6.7	6.4	6.3	6.3	6.3	6.3
99.0Ni	...	B366	...	N02200	Annealed	All	41	(32) (74)	–325	55	15	10.0	10.0	10.0	10.0	10.0	10.0
33Ni–42Fe–21Cr	...	B564	...	N08810	Annealed	...	45	(9)	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
33Ni–42Fe–21Cr–Al–Ti	...	B564	...	N08811	Annealed	...	45	(9)	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
33Ni–42Fe–21Cr	...	B366	...	N08810	Annealed	All	45	(9) (74)	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
33Ni–42Fe–21Cr–Al–Ti	...	B366	...	N08811	Annealed	All	45	(9) (74)	–325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
67Ni–30Cu	...	B564	...	N04400	Annealed	...	42	(9)	–325	70	25	16.7	14.6	13.6	13.2	13.1	13.1
67Ni–30Cu	...	B366	...	N04400	Annealed	All	42	(32) (74)	–325	70	25	16.7	14.6	13.6	13.2	13.1	13.1
72Ni–15Cr–8Fe	...	B366	...	N06600	Annealed	All	43	(32) (74)	–325	75	25	16.7	*16.7*	*16.7*	*16.7*	*16.7*	*16.7*
40Ni–29Cr–15Fe–5Mo	...	B366	...	N06030	Sol. ann.	All	45	(74)	–325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**
40Ni–29Cr–15Fe–5Mo	...	B462	...	N06030	Sol. ann.	All	45	...	–325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**
33Ni–42Fe–21Cr	...	B366	...	N08800	C.D. ann.	All	45	(74)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
33Ni–42Fe–21Cr	...	B564	...	N08800	Annealed	...	45	(9)	–325	75	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	*20.0*
35Ni–35Fe–20Cr–Cb	...	B366	...	N08020	Annealed	All	45	(74)	–325	80	35	23.3	*23.3*	*23.3*	*23.3*	23.3	*23.3*
35Ni–35Fe–20Cr–Cb	...	B462	...	N08020	Annealed	...	45	(9)	–325	80	35	23.3	*23.3*	*23.3*	*23.3*	23.3	*23.3*
72Ni–15Cr–8Fe	...	B564	...	N06600	Annealed	All	43	(9)	–325	80	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	...	B366	...	N08825	C.D. ann.	All	45	(74)	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
42Ni–21.5Cr–3Mo–2.3Cu	...	B564	...	N08825	Annealed	...	45	...	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	Forg.	B564	...	N06690	Annealed	All	43	(9)	–325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
37Ni–33Fe–25Cr	...	B366	...	N08120	Sol. ann.	All	45	...	–325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																							
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	1,550	1,600	1,650	UNS No. or Grade	Spec. No.
Nickel and Nickel Alloy — Plates and Sheets (4a) (Cont'd)																							
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B688
25.6	**25.1**	**24.7**	**24.3**	**23.9**	**23.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08367	B688
27.5	**26.7**	**26.1**	**25.6**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B575
26.2	**25.7**	**25.4**	**25.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B575
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B575
30.0	*30.0*	*30.0*	**29.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10001	B333
33.3	*33.3*	*33.3*	**33.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10001	B333
34.0	*34.0*	34.0	34.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10665	B333
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B333
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B625
Nickel and Nickel Alloy — Forgings and Fittings (4a)																							
6.2	6.2	6.1	6.0	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B160
6.2	6.2	6.1	6.0	5.8	4.5	3.7	3.0	2.4	2.0	1.5	1.2	...	...	...	...	...	...	...	...	...	N02201	B366
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B366
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.8	11.6	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B564
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.8	12.9	10.4	8.3	6.7	5.4	4.3	3.4	2.7	2.2	1.6	1.2	0.91	N08811	B564
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.8	11.6	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B366
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.8	12.9	10.4	8.3	6.7	5.4	4.3	3.4	2.7	2.2	1.6	1.2	0.91	N08811	B366
13.1	13.0	12.9	12.7	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B564
13.1	13.0	12.9	12.7	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B366
16.7	*16.7*	*16.7*	*16.7*	*16.5*	*15.9*	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B366
20.9	**20.5**	**20.1**	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B366
20.9	**20.5**	**20.1**	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B462
20.0	*20.0*	*20.0*	*20.0*	20.0	20.0	20.0	19.9	17.0	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B366
20.0	*20.0*	*20.0*	*20.0*	20.0	20.0	20.0	19.9	17.0	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B564
23.3	23.3	23.2	22.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B366
23.3	23.3	23.2	22.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08020	B462
23.3	*23.3*	*23.3*	*23.3*	23.3	16.0	10.6	7.0	4.5	3.0	2.2	2.0	...	...	...	...	...	...	...	...	...	N06600	B564
23.3	*23.3*	**23.2**	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B366
23.3	*23.3*	**23.2**	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B564
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B564
23.3	**22.9**	**22.6**	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B366

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi Tensile	Yield	Min. Temp. to 100	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)] 200	300	400	500	600
Nickel and Nickel Alloy — Forgings and Fittings (4a)																	
37Ni–33Fe–25Cr	...	B564	...	N08120	Sol. ann.	All	45	...	–325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**
47Ni–22Cr–9Mo–18Fe	...	B366	...	N06002	Sol. ann.	All	43	(32)	–325	100	40	26.7	*26.7*	*26.7*	*26.7*	*25.5*	*24.2*
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B366	...	N08031	Sol. ann.	All	45	(74)	–325	94	40	26.7	*26.7*	**26.7**	**24.7**	**23.3**	**22.2**
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B564	...	N08031	Annealed H.W.	All	45	...	–325	94	40	26.7	*26.7*	**26.7**	**24.7**	**23.3**	**22.2**
54Ni–16Mo–15Cr	...	B366	...	N10276	Sol. ann.	All	43	(74)	–325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
54Ni–16Mo–15Cr	...	B462	...	N10276	Sol. ann.	All	43	(9)	–325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
54Ni–16Mo–15Cr	...	B564	...	N10276	Sol. ann.	All	43	(9)	–325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
62Ni–28Mo–5Fe	...	B366	...	N10001	Sol. ann.	All	44	(32)	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	*30.0*
55Ni–21Cr–13.5Mo	...	B366	...	N06022	Sol. ann.	All	43	(32) (74)	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.0**	**27.6**
55Ni–21Cr–13.5Mo	...	B462	...	N06022	Sol. ann.	All	43	(9)	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**30.0**	**27.6**
55Ni–21Cr–13.5Mo	...	B564	...	N06022	Sol. ann.	All	43	(9)	–325	100	45	30.0	*30.0*	*30.0*	30.0	**29.0**	**27.6**
58Ni–33Cr–8Mo	...	B366	...	N06035	Sol. ann.	All	43	(32) (74)	–325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
58Ni–33Cr–8Mo	...	B462	...	N06035	Sol. ann.	All	43	(9)	–325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
58Ni–33Cr–8Mo	...	B564	...	N06035	Sol. ann.	All	43	(9)	–325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
59Ni–23Cr–16Mo	...	B366	...	N06059	Sol. ann.	All	43	(74)	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.7**	**28.2**
59Ni–23Cr–16Mo	...	B564	...	N06059	H.W. sol. ann.	All	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.7**	**28.2**
59Ni–23Cr–16Mo–1.6Cu	...	B366	...	N06200	Sol. ann.	All	43	(74)	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
59Ni–23Cr–16Mo–1.6Cu	...	B462	...	N06200	Sol. ann.	All	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
59Ni–23Cr–16Mo–1.6Cu	...	B564	...	N06200	Sol. ann.	All	43	...	–325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
62Ni–22Mo–15Cr	...	B366	...	N10362	Sol. ann.	All	43	(9)	–325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–22Mo–15Cr	...	B462	...	N10362	Sol. ann.	All	43	(9)	–325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
62Ni–22Mo–15Cr	...	B564	...	N10362	Sol. ann.	All	43	(9)	–325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
60Ni–22Cr–9Mo–3.5Cb	...	B564	...	N06625	Annealed	≤4	43	(9) (64)	–325	120	60	40.0	*40.0*	*39.6*	*39.2*	**38.6**	**37.8**
65Ni–28Mo–2Fe	...	B366	...	N10665	Sol. ann.	All	44	(74)	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B366	...	N10675	Sol. ann.	All	44	(74)	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B462	...	N10675	Sol. ann.	All	44	...	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
65Ni–29.5Mo–2Fe–2Cr	...	B564	...	N10675	Sol. ann.	All	44	...	–325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
57Ni–22Cr–14W–2Mo–La	...	B564	...	N06230	Sol. ann.	All	43	...	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
57Ni–22Cr–14W–2Mo–La	...	B366	...	N06230	Sol. ann.	All	43	(74)	–325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B366	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B462	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B564	...	R20033	Sol. ann.	All	45	...	–325	109	55	36.3	30.9	28.1	26.1	24.7	23.8
Nickel and Nickel Alloy — Rod and Bar (4a)																	
99.0Ni	...	B160	...	N02200	H.W.	All	41	(9)	–325	60	15	10.0	10.0	10.0	10.0	10.0	10.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																					UNS No. or Grade	Spec. No.
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	1,550	1,600	1,650		
Nickel and Nickel Alloy — Forgings and Fittings (4a) (Cont'd)																						
23.3	**22.9**	**22.6**	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B564
23.7	*23.3*	*22.9*	*22.7*	*22.5*	*19.6*	*19.5*	*19.3*	*19.3*	*17.5*	14.1	11.3	9.3	7.7	6.1	4.8	3.8	3.0	...	...	...	N06002	B366
21.7	**21.3**	**20.9**	**20.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B366
21.7	**21.3**	**20.9**	**20.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B564
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B366
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B462
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B564
30.0	*30.0*	*30.0*	*29.9*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10001	B366
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B366
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B462
27.0	**26.5**	**26.1**	**25.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06022	B564
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B366
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B462
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B564
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B366
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B564
26.2	**25.7**	**25.4**	**25.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B366
26.2	**25.7**	**25.4**	**25.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B462
26.2	**25.7**	**25.4**	**25.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B564
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B366
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B462
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B564
37.4	37.0	36.6	36.3	36.1	35.8	35.4	31.2	31.2	23.1	21.0	13.2	...	...	...	...	...	...	...	...	...	N06625	B564
34.0	*34.0*	*34.0*	*34.0*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10665	B366
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B366
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B462
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B564
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B564
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B366
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B366
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B462
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B564
Nickel and Nickel Alloy — Rod and Bar (4a)																						
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B160

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi Tensile	Yield	Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)] Min. Temp. to 100	200	300	400	500	600
Nickel and Nickel Alloy — Rod and Bar (4a)																	
99.0Ni	...	B160	...	N02200	Annealed	All	41	(9)	−325	55	15	10.0	10.0	10.0	10.0	10.0	10.0
67Ni–30Cu	...	B164	...	N04400	Ann. forg.	All	42	(13)	−325	70	25	16.7	14.6	13.6	13.2	13.1	13.1
33Ni–42Fe–21Cr	Bar	B408	...	N08810	Sol. tr. or ann.	...	45	...	−325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
33Ni–42Fe–21Cr–Al–Ti	Bar	B408	...	N08811	Sol. tr. or ann.	...	45	...	−325	65	25	16.7	16.7	16.7	16.7	16.7	16.5
33Ni–42Fe–21Cr	Bar	B408	...	N08800	H.F.	...	45	...	−325	75	30	20.0	20.0	20.0	20.0	20.0	20.0
26Ni–22Cr–5Mo–Ti	...	B621	...	N08320	Sol. ann.	All	45	...	−325	75	28	18.7	*18.7*	*18.7*	*18.7*	*18.7*	*18.6*
47Ni–22Cr–19Fe–6Mo	...	B581	...	N06007	Sol. ann.	>3/4	45	...	−325	85	30	20.0	*20.0*	*20.0*	*20.0*	*20.0*	**19.5**
42Ni–21.5Cr–3Mo–2.3Cu	...	B425	...	N08825	Annealed	...	45	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	Bar	B166	...	N06690	H.R.	>3	43	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
58Ni–29Cr–9Fe	Bar	B166	...	N06690	H.R or C.D. ann.	All	43	...	−325	85	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*
47Ni–22Cr–19Fe–6Mo	...	B581	...	N06007	Sol. ann.	≤3/4	45	...	−325	90	35	23.3	*23.3*	*23.3*	*23.3*	*23.3*	**22.7**
40Ni–29Cr–15Fe–5Mo	...	B581	...	N06030	Sol. ann.	All	45	...	−325	85	35	23.3	*23.3*	*23.3*	**23.2**	**22.1**	**21.3**
37Ni–33Fe–25Cr	...	B408	...	N08120	Sol. ann.	All	45	...	−325	90	40	26.7	*26.7*	*26.7*	*26.7*	**25.1**	**24.4**
31Ni–33Fe–27Cr–6.5Mo–Cu–N	...	B649	...	N08031	Annealed	All	45	...	−325	94	40	26.7	*26.7*	*26.7*	*24.7*	**23.3**	**22.2**
67Ni–30Cu	...	B164	...	N04400	H.W.	All except hex. >2 1/8	42	...	−325	80	40	26.7	25.8	24.8	23.9	23.4	23.1
58Ni–33Cr–8Mo	...	B574	...	N06035	Sol. ann.	All	43	(9)	−325	85	35	23.3	*23.3*	*23.3*	**22.2**	**20.6**	**19.7**
61Ni–16Mo–16Cr	...	B574	...	N06455	Sol. ann.	All	43	(9)	−325	100	40	26.7	*26.7*	*26.7*	*26.7*	*26.7*	*26.7*
54Ni–16Mo–15Cr	...	B574	...	N10276	Sol. ann.	All	43	...	−325	100	41	27.3	*27.3*	*27.3*	*27.3*	**26.9**	**25.2**
62Ni–22Mo–15Cr	...	B574	...	N10362	Sol. ann.	All	43	(9)	−325	105	45	30.0	*30.0*	*30.0*	*30.0*	**28.9**	**27.7**
60Ni–22Cr–9Mo–3.5Cb	...	B446	1	N06625	Annealed	>4 to 10	43	(9) (64) (70)	−325	110	50	33.3	*33.3*	*33.3*	*33.3*	33.3	33.3
60Ni–22Cr–9Mo–3.5Cb	...	B446	1	N06625	Annealed	≤4	43	(9) (64) (70)	−325	120	60	40.0	*40.0*	*40.0*	*40.0*	**38.3**	**38.0**
57Ni–22Cr–14W–2Mo–La	...	B572	...	N06230	Sol. ann.	All	43	...	−325	110	45	30.0	*30.0*	*30.0*	*30.0*	*30.0*	**29.6**
59Ni–23Cr–16Mo	...	B574	...	N06059	Sol. ann.	All	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**29.7**	**28.2**
59Ni–23Cr–16Mo–1.6Cu	...	B574	...	N06200	Sol. ann.	All	43	...	−325	100	45	30.0	*30.0*	*30.0*	*30.0*	**28.6**	**26.9**
65Ni–29.5Mo–2Fe–2Cr	...	B335	...	N10675	Sol. ann.	All	44	...	−325	110	51	34.0	*34.0*	*34.0*	*34.0*	*34.0*	*34.0*
33Cr–31Ni–32Fe–1.5Mo–0.6Cu–N	...	B649	...	R20033	Sol. ann.	All	45	...	−325	109	55	36.3	30.9	28.1	26.1	24.7	23.8

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																					UNS No. or Grade	Spec. No.
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	1,550	1,600	1,650		
Nickel and Nickel Alloy — Rod and Bar (4a) (Cont'd)																						
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N02200	B160
13.1	13.0	12.9	12.7	11.0	8.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B164
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.8	11.6	9.3	7.4	5.9	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.86	N08810	B408
16.1	15.7	15.3	15.0	14.7	14.5	14.2	14.0	13.7	12.9	10.4	8.3	6.7	5.4	4.3	3.4	2.7	2.2	1.6	1.2	0.91	N08811	B408
20.0	20.0	20.0	20.0	20.0	20.0	20.0	19.9	17.0	13.0	9.8	6.6	4.2	2.0	1.6	1.1	1.0	0.8	...	...	...	N08800	B408
18.2	*17.8*	*17.5*	*17.2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08320	B621
19.2	**19.0**	18.8	**18.7**	18.6	18.5	18.4	18.3	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B581
23.3	*23.3*	**23.2**	**23.0**	**22.9**	**22.8**	**22.6**	**22.3**	...	...	...	...	...	...	...	...	...	...	...	...	...	N08825	B425
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B166
23.3	*23.3*	*23.3*	*23.3*	*23.3*	*23.3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06690	B166
22.4	*22.2*	*22.0*	*21.8*	*21.7*	*20.0*	*19.5*	*18.9*	...	...	...	...	...	...	...	...	...	...	...	...	...	N06007	B581
20.9	**20.5**	**20.1**	**19.7**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06030	B581
23.3	**22.9**	**22.6**	**22.4**	**22.2**	**22.1**	**22.0**	**21.9**	**21.9**	17.9	14.2	12.3	9.4	7.6	6.2	5.0	4.0	3.2	2.6	2.0	1.4	N08120	B408
21.7	**21.3**	**20.9**	**20.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N08031	B649
22.9	22.7	20.0	14.5	8.5	4.0	1.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N04400	B164
19.4	**19.2**	**19.0**	**18.8**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06035	B574
26.7	*26.5*	*26.1*	*25.8*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06455	B574
24.6	**24.0**	**23.5**	**23.1**	**22.8**	**22.6**	**22.4**	**22.3**	18.5	15.0	12.2	9.8	7.8	...	...	...	...	...	...	...	...	N10276	B574
27.3	**27.0**	**26.7**	**26.4**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10362	B574
33.3	33.3	33.3	33.3	33.1	32.8	32.5	31.2	31.2	23.1	21.0	13.2	...	...	...	...	...	...	...	...	...	N06625	B446
37.7	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	27.7	21.0	13.2	...	...	...	...	...	...	...	...	N06625	B446
29.1	**28.7**	**28.4**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	**28.2**	23.2	19.0	15.6	12.9	10.6	8.5	6.7	5.3	4.1	2.9	2.1	1.5	N06230	B572
27.5	**26.8**	**26.1**	**25.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06059	B574
26.2	**25.7**	**25.4**	**25.2**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N06200	B574
34.0	*34.0*	**33.9**	**33.5**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	N10675	B335
23.5	23.1	22.9	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R20033	B649

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]					
										Tensile	Yield	Min. Temp. to 100	200	300	400	500	600
Nickel and Nickel Alloy — Castings (4a)																	
59Ni–22Cr–14Mo–4Fe–3W	...	A494	CX2MW	N26022	...	...	43	(9)	−325	80	45	26.7	26.7	26.7	26.7	26.7	...
53Ni–17Mo–16Cr–6Fe–5W	...	A494	CW12-MW	N30002	...	...	a	(7) (9)	−325	72	40	24.0	24.0	24.0	24.0	24.0	24.0
56Ni–19Mo–18Cr–2Fe	...	A494	CW6M	N30107	...	...	44	(9)	−325	72	40	24.0	24.0	24.0	24.0	24.0	24.0

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]																							
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	1,550	1,600	1,650	UNS No. or Grade	Spec. No.
																					Nickel and Nickel Alloy — Castings (4a)	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CX2MW	A494
24.0	24.0	24.0	24.0	24.0	24.0	24.0	22.8	...	...	...	...	...	...	...	...	...	...	...	...	...	CW12M-W	A494
24.0	24.0	24.0	24.0	24.0	24.0	24.0	22.8	...	...	...	...	...	...	...	...	...	...	...	...	...	CW6M	A494

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi	
									Tensile	Yield
Titanium and Titanium Alloy — Pipes and Tubes										
Ti	Smls. & wld. tube	B338	1	R50250	Annealed	51	...	−75	35	20
Ti	Smls. pipe	B861	1	R50250	Annealed	51	...	−75	35	20
Ti	Wld. pipe	B862	1	R50250	Annealed	51	...	−75	35	20
Ti	Smls. & wld. tube	B338	2	R50400	Annealed	51	...	−75	50	40
Ti	Smls. pipe	B861	2	R50400	Annealed	51	...	−75	50	40
Ti	Wld. pipe	B862	2	R50400	Annealed	51	...	−75	50	40
Ti	Smls. & wld. tube	B338	3	R50550	Annealed	52	...	−75	65	55
Ti	Smls. pipe	B861	3	R50550	Annealed	52	...	−75	65	55
Ti	Wld. pipe	B862	3	R50550	Annealed	52	...	−75	65	55
Ti–Pd	Smls. & wld. tube	B338	7	R52400	Annealed	51	...	−75	50	40
Ti–Pd	Smls. pipe	B861	7	R52400	Annealed	51	...	−75	50	40
Ti–Pd	Wld. pipe	B862	7	R52400	Annealed	51	...	−75	50	40
Ti–0.3Mo–0.8Ni	Smls. & wld. tube	B338	12	R53400	Annealed	52	...	−75	70	50
Ti–0.3Mo–0.8Ni	Smls. pipe	B861	12	R53400	Annealed	52	...	−75	70	50
Ti–0.3Mo–0.8Ni	Wld. pipe	B862	12	R53400	Annealed	52	...	−75	70	50
Titanium and Titanium Alloy — Plates, Sheets, and Strips										
Ti	...	B265	1	R50250	Annealed	51	...	−75	35	20
Ti	...	B265	2	R50400	Annealed	51	...	−75	50	40
Ti	...	B265	3	R50550	Annealed	52	...	−75	65	55
Ti–Pd	...	B265	7	R52400	Annealed	51	...	−75	50	40
Ti–0.3Mo–0.8Ni	...	B265	12	R53400	Annealed	52	...	−75	70	50
Titanium and Titanium Alloy — Forgings and Fittings										
Ti	Fittings	B363	WPT1	R50250	Annealed	51	...	−75	35	20
Ti	Forgings	B381	F-1	R50250	Annealed	51	...	−75	35	20
Ti	Fittings	B363	WPT2	R50400	Annealed	51	...	−75	50	40
Ti	Forgings	B381	F-2	R50400	Annealed	51	...	−75	50	40
Ti	Fittings	B363	WPT3	R50550	Annealed	52	...	−75	65	55
Ti	Forgings	B381	F-3	R50550	Annealed	52	...	−75	65	55
Ti–Pd	Fittings	B363	WPT7	R52400	Annealed	51	...	−75	50	40
Ti–Pd	Forgings	B381	F-7	R52400	Annealed	51	...	−75	50	40
Ti–0.3Mo–0.8Ni	Fittings	B363	WPT12	R53400	Annealed	52	...	−75	70	50
Ti–0.3Mo–0.8Ni	Forgings	B381	F-12	R53400	Annealed	52	...	−75	70	50
Titanium and Titanium Alloy — Bars										
Ti	...	B348	1	R50250	Annealed	51	...	−75	35	20
Ti	...	B348	2	R50400	Annealed	51	...	−75	50	40
Ti	...	B348	3	R50550	Annealed	52	...	−75	65	55

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]														
Min. Temp. to 100	150	200	250	300	350	400	450	500	550	600	650	700	UNS No.	Spec. No.
Titanium and Titanium Alloy — Pipes and Tubes														
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B338
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B861
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B862
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B338
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B861
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B862
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B338
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B861
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B862
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B338
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B861
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B862
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B338
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B861
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B862
Titanium and Titanium Alloy — Plates, Sheets, and Strips														
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B265
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B265
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B265
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B265
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B265
Titanium and Titanium Alloy — Forgings and Fittings														
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B363
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B381
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B363
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B381
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B363
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B381
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B363
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B381
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B363
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B381
Titanium and Titanium Alloy — Bars														
11.7	10.7	9.3	8.2	7.2	6.3	5.5	4.7	4.2	3.8	3.5	...	...	R50250	B348
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R50400	B348
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	9.3	8.6	...	...	R50550	B348

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Product Form	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi	
									Tensile	Yield
Titanium and Titanium Alloy — Bars										
Ti–Pd	...	B348	7	R52400	Annealed	51	...	–75	50	40
Ti–0.3Mo–0.8Ni	...	B348	12	R53400	Annealed	52	...	–75	70	50
Titanium and Titanium Alloy — Castings										
Ti	...	B367	C-2	R52550	...	51	(14) (44)	–75	50	40
Ti	...	B367	C-3	R52550	...	52	(14) (44)	–75	65	55
Ti–Pd	...	B367	C-7	R52700	...	51	(14) (44)	–75	50	40
Zirconium and Zirconium Alloy — Pipes and Tubes										
99.2Zr	Smls. & wld. tube	B523	...	R60702		61	...	–75	55	30
99.2Zr	Smls. & wld. tube	B658	...	R60702		61	...	–75	55	30
95.5Zr + 2.5Nb	Smls. & wld. pipe	B658	...	R60705		62	(73)	–75	80	55
Zirconium and Zirconium Alloy — Plates and Sheets										
99.2Zr	Plate, sheet, strip	B551	...	R60702		61	...	–75	55	30
95.5Zr + 2.5Nb	Plate, sheet, strip	B551	...	R60705		62	(73)	–75	80	55
Zirconium and Zirconium Alloy — Forgings and Bar										
99.2Zr	Forgings	B493	...	R60702		61	...	–75	55	30
99.2Zr	Bar, wire	B550	...	R60702		61	...	–75	55	30
95.5Zr + 2.5Nb	Forgings	B493	...	R60705		62	(73)	–75	70	55
95.5Zr + 2.5Nb	Bar, wire	B550	...	R60705		62	(73)	–75	80	55

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]														
Min. Temp. to 100	150	200	250	300	350	400	450	500	550	600	650	700	UNS No.	Spec. No.
Titanium and Titanium Alloy — Bars (Cont'd)														
16.7	15.6	14.5	13.3	12.1	11.2	10.3	9.6	8.9	8.2	7.6	...	...	R52400	B348
23.3	22.6	21.8	20.4	18.9	17.8	16.7	16.0	15.2	14.8	14.4	...	...	R53400	B348
Titanium and Titanium Alloy — Castings														
16.7	15.2	13.8	12.6	11.4	10.4	9.5	8.7	7.9	...	...	...	...	R52550	B367
21.7	20.0	18.4	16.6	14.9	13.5	12.1	11.0	9.9	...	...	...	...	R52550	B367
16.7	15.2	13.8	12.6	11.4	10.4	9.5	8.7	7.9	...	...	...	...	R52700	B367
Zirconium and Zirconium Alloy — Pipes and Tubes														
18.3	17.2	15.4	13.6	12.0	10.6	9.3	8.3	7.4	6.6	6.0	5.6	5.2	R60702	B523
18.3	17.2	15.4	13.6	12.0	10.6	9.3	8.3	7.4	6.6	6.0	5.6	5.2	R60702	B658
26.7	24.4	22.1	20.4	18.9	17.7	16.7	15.8	15.0	14.4	13.9	13.5	13.2	R60705	B658
Zirconium and Zirconium Alloy — Plates and Sheets														
18.3	17.2	15.4	13.6	12.0	10.6	9.3	8.3	7.4	6.6	6.0	5.6	5.2	R60702	B551
26.7	24.4	22.1	20.4	18.9	17.7	16.7	15.8	15.0	14.4	13.9	13.5	13.2	R60705	B551
Zirconium and Zirconium Alloy — Forgings and Bar														
18.3	17.2	15.4	13.6	12.0	10.6	9.3	8.3	7.4	6.6	6.0	5.6	5.2	R60702	B493
18.3	17.2	15.4	13.6	12.0	10.6	9.3	8.3	7.4	6.6	6.0	5.6	5.2	R60702	B550
23.3	21.3	19.3	17.8	16.5	15.5	14.6	13.8	13.1	12.6	12.2	11.8	11.5	R60705	B493
26.7	24.4	22.1	20.4	18.9	17.7	16.7	15.8	15.0	14.4	13.9	13.5	13.2	R60705	B550

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Seamless Pipes and Tubes																	
Al–Mn–Cu	B210	Alclad 3003	A83003	O	...	21	(14) (33)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B210	Alclad 3003	A83003	H112	...	21	(14) (33)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B241	Alclad 3003	A83003	O	...	21	(14) (33)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B241	Alclad 3003	A83003	H112	...	21	(14) (33)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B210	Alclad 3003	A83003	H14	...	21	(14) (33)	−452	19	16	6.3	6.3	6.3	6.1	4.3	3.0	2.3
Al–Mn–Cu	B210	Alclad 3003	A83003	H18	...	21	(14) (33)	−452	26	23	8.7	8.7	8.7	8.4	4.3	3.0	2.3
99.60Al	B210	1060	A91060	O	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B210	1060	A91060	H112	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B210	1060	A91060	H113	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B241	1060	A91060	O	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B241	1060	A91060	H112	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B241	1060	A91060	H113	...	21	(14) (33)	−452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.60Al	B210	1060	A91060	H14	...	21	(14) (33)	−452	12	10	4.0	4.0	4.0	4.0	2.7	1.8	1.1
99.0Al–Cu	B241	1100	A91100	O	...	21	(14) (33)	−452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
99.0Al–Cu	B241	1100	A91100	H112	...	21	(14) (33)	−452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
99.0Al–Cu	B210	1100	A91100	H113	...	21	(14) (33)	−452	11	3.5	2.3	2.3	2.3	2.3	1.7	1.3	1.0
99.0Al–Cu	B210	1100	A91100	H14	...	21	(14) (33)	−452	16	14	5.3	5.3	5.3	4.9	2.8	1.9	1.1
Al–Mn–Cu	B210	3003	A93003	O	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B210	3003	A93003	H112	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B241	3003	A93003	O	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B241	3003	A93003	H112	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B491	3003	A93003	O	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B491	3003	A93003	H112	...	21	(14) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B210	3003	A93003	H14	...	21	(14) (33)	−452	20	17	6.7	6.7	6.5	4.8	4.3	3.0	2.3
Al–Mn–Cu	B210	3003	A93003	H18	...	21	(14) (33)	−452	27	24	9.0	9.0	8.7	8.0	5.3	3.5	2.5
Al–Mn–Cu	B241	3003	A93003	H18	...	21	(14) (33)	−452	27	24	9.0	9.0	8.7	8.0	5.3	3.5	2.5
Al–2.5Mg	B210	5052	A95052	O	...	22	(14)	−452	25	10	6.7	6.7	6.7	6.6	6.1	4.1	2.3
Al–2.5Mg	B241	5052	A95052	O	...	22	(14)	−452	25	10	6.7	6.7	6.7	6.6	6.1	4.1	2.3
Al–2.5Mg	B210	5052	A95052	H32	...	22	(14) (33)	−452	31	23	10.3	10.3	10.3	10.3	6.1	4.1	2.3
Al–2.5Mg	B210	5052	A95052	H34	...	22	(14) (33)	−452	34	26	11.3	11.3	11.3	11.3	6.1	4.1	2.3
Al–4.4Mg–Mn	B210	5083	A95083	O	...	25	(33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–4.4Mg–Mn	B210	5083	A95083	H112	...	25	(33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–4.4Mg–Mn	B241	5083	A95083	O	...	25	(33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–4.4Mg–Mn	B241	5083	A95083	H112	...	25	(33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–4.0Mg–Mn	B210	5086	A95086	O	...	25	(33)	−452	35	14	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B210	5086	A95086	H112	...	25	(33)	−452	35	14	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B241	5086	A95086	O	...	25	(33)	−452	35	14	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B241	5086	A95086	H112	...	25	(33)	−452	35	14	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B210	5086	A95086	H32	...	25	(33)	−452	40	28	13.3	13.3	...	...	...	...	...

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Seamless Pipes and Tubes (Cont'd)																	
Al–4.0Mg–Mn	B210	5086	A95086	H34	...	25	(33)	–452	44	34	14.7	14.7	...	...	...	...	...
Al–3.5Mg	B210	5154	A95154	O	...	22	...	–452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B210	5154	A95154	H34	...	22	(33)	–452	39	29	13.3	13.0	...	...	...	...	...
Al–2.7Mg–Mn	B241	5454	A95454	O	...	22	(33)	–452	31	12	8.0	8.0	8.0	7.4	5.5	4.1	3.0
Al–2.7Mg–Mn	B241	5454	A95454	H112	...	22	(33)	–452	31	12	8.0	8.0	8.0	7.4	5.5	4.1	3.0
Al–5.1Mg–Mn	B210	5456	A95456	O	...	25	(33)	–452	41	19	12.7	12.7	...	...	...	...	...
Al–5.1Mg–Mn	B210	5456	A95456	H112	...	25	(33)	–452	41	19	12.7	12.7	...	...	...	...	...
Al–5.1Mg–Mn	B241	5456	A95456	O	...	25	(33)	–452	41	19	12.7	12.7	...	...	...	...	...
Al–5.1Mg–Mn	B241	5456	A95456	H112	...	25	(33)	–452	41	19	12.7	12.7	...	...	...	...	...
Al–Mg–Si–Cu	B210	6061	A96061	T4 wld.	...	23	(22) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B210	6061	A96061	T6 wld.	...	23	(22) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B241	6061	A96061	T4 wld.	...	23	(22) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B241	6061	A96061	T6 wld.	...	23	(22) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B241	6061	A96061	T4	...	23	(33) (63)	–452	26	16	8.7	8.7	8.7	8.7	8.3	7.4	5.2
Al–Mg–Si–Cu	B210	6061	A96061	T4	...	23	(33)	–452	30	16	10.0	10.0	10.0	9.9	9.5	8.4	5.2
Al–Mg–Si–Cu	B241	6061	A96061	T6	...	23	(33) (63)	–452	38	35	12.7	12.7	12.7	12.3	10.5	8.1	5.2
Al–Mg–Si–Cu	B210	6061	A96061	T6	...	23	(33)	–452	42	35	14.0	14.0	14.0	13.6	11.7	8.9	5.2
Al–Mg–Si	B210	6063	A96063	T4 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B210	6063	A96063	T5 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B210	6063	A96063	T6 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B241	6063	A96063	T4 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B241	6063	A96063	T5 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B241	6063	A96063	T6 wld.	...	23	...	–452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B241	6063	A96063	T4	≤0.500	23	(33)	–452	19	10	6.3	6.3	6.3	6.3	5.8	3.9	1.5
Al–Mg–Si	B210	6063	A96063	T4	...	23	(33)	–452	22	10	6.7	6.5	6.5	6.3	6.3	4.5	1.7
Al–Mg–Si	B241	6063	A96063	T5	≤0.500	23	(33)	–452	22	16	7.3	7.3	7.3	7.3	7.1	3.8	2.0
Al–Mg–Si	B241	6063	A96063	T6	...	23	(33)	–452	30	25	10.0	10.0	10.0	9.1	7.2	3.4	2.0
Al–Mg–Si	B210	6063	A96063	T6	...	23	(33)	–452	33	28	11.0	11.0	11.0	9.6	7.3	3.8	2.0
Aluminum Alloy — Structural Tubes																	
Al–Mn–Cu	B221	Alclad 3003	A83003	O	...	21	(33) (69)	–452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B221	Alclad 3003	A83003	H112	...	21	(33) (69)	–452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
99.0Al	B221	1060	A91060	O	...	21	(33) (69)	–452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.0Al	B221	1060	A91060	H112	...	21	(33) (69)	–452	8.5	2.5	1.7	1.7	1.6	1.4	1.2	1.1	0.8
99.0Al–Cu	B221	1100	A91100	O	...	21	(33) (69)	–452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
99.0Al–Cu	B221	1100	A91100	H112	...	21	(33) (69)	–452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
Al–Mn–Cu	B221	3003	A93003	O	...	21	(33) (69)	–452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B221	3003	A93003	H112	...	21	(33) (69)	–452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Structural Tubes (Cont'd)																	
Al–2.5Mg	B221	5052	A95052	O	...	22	(69)	−452	25	10	6.7	6.7	6.7	6.6	6.1	4.1	2.3
Al–4.4Mg–Mn	B221	5083	A95083	O	...	25	(69)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–4.0Mg–Mn	B221	5086	A95086	O	...	25	(69)	−452	35	14	9.3	9.3	...	...	...	...	...
Al–3.5Mg	B221	5154	A95154	O	...	22	(69)	−452	30	11	7.3	7.3	...	...	...	...	...
Al–2.7Mg–Mn	B221	5454	A95454	O	...	22	(69)	−452	31	12	8.0	8.0	8.0	7.4	5.5	4.1	3.0
Al–5.1Mg–Mn	B221	5456	A95456	O	...	25	(69)	−452	41	19	12.7	12.7	...	...	...	...	...
Al–Mg–Si–Cu	B221	6061	A96061	T4 wld.	...	23	(22) (63) (69)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B221	6061	A96061	T6 wld.	...	23	(22) (63) (69)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B221	6061	A96061	T4	...	23	(33) (63) (69)	−452	26	16	8.7	8.7	8.7	8.7	8.3	7.4	5.2
Al–Mg–Si–Cu	B221	6061	A96061	T6	...	23	(33) (63) (69)	−452	38	35	12.7	12.7	12.7	12.3	10.5	8.1	5.2
Al–Mg–Si	B221	6063	A96063	T4 wld.	...	23	(69)	−452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B221	6063	A96063	T5 wld.	...	23	(69)	−452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B221	6063	A96063	T6 wld.	...	23	(69)	−452	17	...	5.7	5.7	5.6	5.3	4.8	3.8	2.0
Al–Mg–Si	B221	6063	A96063	T4	≤0.500	23	(13) (33) (69)	−452	19	10	6.3	6.3	6.3	6.3	5.8	3.9	1.5
Al–Mg–Si	B221	6063	A96063	T5	≤0.500	23	(13) (33) (69)	−452	22	16	7.3	7.3	7.3	7.3	7.1	3.8	2.0
Al–Mg–Si	B221	6063	A96063	T6	...	23	(33) (69)	−452	30	25	10.0	10.0	10.0	9.1	7.2	3.4	2.0
Aluminum Alloy — Plates and Sheets																	
Al–Mn–Cu	B209	Alclad 3003	A83003	O	0.006–0.499	21	(66)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B209	Alclad 3003	A83003	O	0.500–3.000	21	(68)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B209	Alclad 3003	A83003	H112	0.500–2.000	21	(33) (66)	−452	15	6	4.0	3.9	3.7	3.6	2.7	1.9	1.5
Al–Mn–Cu	B209	Alclad 3003	A83003	H12	0.017–0.499	21	(33) (66)	−452	16	11	5.3	5.3	5.2	4.9	4.3	3.0	2.3
Al–Mn–Cu	B209	Alclad 3003	A83003	H12	0.500–2.000	21	(33) (68)	−452	17	12	5.7	5.7	5.7	5.7	4.3	3.0	2.3
Al–Mn–Cu	B209	Alclad 3003	A83003	H14	0.009–0.499	21	(33) (66)	−452	19	16	6.3	6.3	6.3	6.1	4.3	3.0	2.3
Al–Mn–Cu	B209	Alclad 3003	A83003	H14	0.500–1.000	21	(33) (68)	−452	20	17	6.7	6.7	6.7	6.5	4.3	3.0	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	O	0.006–0.499	22	(66)	−452	21	8	5.3	5.3	5.3	5.3	5.3	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	O	0.500–3.000	22	(68)	−452	22	8.5	5.7	5.6	5.6	5.6	5.6	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H112	0.250–0.499	22	(33) (66)	−452	22	8.5	5.7	5.6	5.6	5.6	5.6	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H112	0.500–3.000	22	(33) (68)	−452	23	9	6.0	6.0	6.0	6.0	5.7	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H32	0.017–0.499	22	(33) (66)	−452	27	20	9.0	9.0	9.0	9.0	5.7	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H32	0.500–2.000	22	(33) (68)	−452	28	21	9.3	9.3	9.3	9.3	5.7	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H34	0.009–0.499	22	(33) (66)	−452	31	24	10.3	10.3	10.3	10.3	5.7	3.8	2.3
Al–Mn–Mg	B209	Alclad 3004	A83004	H34	0.500–1.000	22	(33) (68)	−452	32	25	10.7	10.7	10.7	10.7	5.7	3.8	2.3
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T4 wld.	...	23	(22) (63)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T6 wld.	...	23	(22) (63)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T4	...	23	(33) (66)	−452	27	14	9.0	9.0	9.0	8.9	8.6	7.6	5.2
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T451	0.250–0.499	23	(33) (66)	−452	27	14	9.0	9.0	9.0	8.9	8.6	7.6	5.2
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T451	0.500–3.000	23	(33) (68)	−452	30	16	9.0	9.0	9.0	8.9	8.5	8.4	5.2

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Plates and Sheets (Cont'd)																	
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T6	...	23	(33) (66)	−452	38	32	12.7	12.7	12.7	12.3	10.6	8.1	5.2
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T651	0.250–0.499	23	(33) (66)	−452	38	32	12.7	12.7	12.7	12.3	10.6	8.1	5.2
Al–Mg–Si–Cu	B209	Alclad 6061	A86061	T651	0.500–4.000	23	(33) (68)	−452	42	35	14.0	14.0	14.0	13.6	11.7	8.9	5.2
99.60Al	B209	1060	A91060	O	...	21	...	−452	8	2.5	1.7	1.6	1.6	1.4	1.2	1.1	0.8
99.60Al	B209	1060	A91060	H112	0.500–1.000	21	(13) (33)	−452	10	5	3.3	3.2	2.9	2.5	2.0	1.5	0.9
99.60Al	B209	1060	A91060	H12	...	21	(33)	−452	11	9	3.7	3.7	3.4	3.1	2.7	1.8	1.1
99.60Al	B209	1060	A91060	H14	...	21	(33)	−452	12	10	4.0	4.0	4.0	4.0	2.7	1.8	1.1
99.0Al–Cu	B209	1100	A91100	O	...	21	...	−452	11	3.5	2.3	2.3	2.3	2.3	1.7	1.3	1.0
99.0Al–Cu	B209	1100	A91100	H112	0.500–2.000	21	(13) (33)	−452	12	5	3.3	3.3	3.3	3.2	2.4	1.7	1.0
99.0Al–Cu	B209	1100	A91100	H12	...	21	(33)	−452	14	11	4.7	4.7	4.6	3.8	2.8	1.9	1.1
99.0Al–Cu	B209	1100	A91100	H14	...	21	(33)	−452	16	14	5.3	5.3	5.3	4.9	2.8	1.9	1.1
Al–Mn–Cu	B209	3003	A93003	O	...	21	...	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B209	3003	A93003	H112	0.500–2.000	21	(13) (33)	−452	15	6	4.0	3.9	3.7	3.6	2.7	1.9	1.5
Al–Mn–Cu	B209	3003	A93003	H12	...	21	(33)	−452	17	12	5.7	5.7	5.6	5.2	4.3	3.0	2.3
Al–Mn–Cu	B209	3003	A93003	H14	...	21	(33)	−452	20	17	6.7	6.7	6.7	6.5	4.3	3.0	2.3
Al–Mn–Mg	B209	3004	A93004	O	...	22	...	−452	22	8.5	5.7	5.7	5.7	5.7	5.7	3.8	2.3
Al–Mn–Mg	B209	3004	A93004	H112	...	22	(33)	−452	23	9	6.0	6.0	6.0	6.0	5.8	3.8	2.3
Al–Mn–Mg	B209	3004	A93004	H32	...	22	(33)	−452	28	21	9.3	9.3	9.3	9.3	5.7	3.8	2.3
Al–Mn–Mg	B209	3004	A93004	H34	...	22	(33)	−452	32	25	10.7	10.7	10.7	10.7	5.7	3.8	2.3
Al–1.5Mg	B209	5050	A95050	O	...	21	...	−452	18	6	4.0	4.0	4.0	4.0	4.0	2.8	1.4
Al–1.5Mg	B209	5050	A95050	H112	...	21	(33)	−452	20	8	5.3	5.3	5.3	5.2	5.2	2.8	1.4
Al–1.5Mg	B209	5050	A95050	H32	...	21	(33)	−452	22	16	7.3	7.3	7.3	7.3	5.3	2.8	1.4
Al–1.5Mg	B209	5050	A95050	H34	...	21	(33)	−452	25	20	8.3	8.3	8.3	7.8	5.3	2.8	1.4
Al–2.5Mg	B209	5052	A95052	O	...	22	...	−452	25	9.5	6.3	6.3	6.3	6.2	6.1	4.1	2.3
Al–2.5Mg	B209	5052	A95052	H112	0.500–3.000	22	(13) (33)	−452	25	9.5	6.3	6.3	6.3	6.3	6.1	4.1	2.3
Al–2.5Mg	B209	5052	A95052	H32	...	22	(33)	−452	31	23	10.3	10.3	10.3	10.3	6.1	4.1	2.3
Al–2.5Mg	B209	5052	A95052	H34	...	22	(33)	−452	34	26	11.3	11.3	11.3	11.3	6.1	4.1	2.3
Al–4.4Mg–Mn	B209	5083	A95083	O	0.051–1.500	25	(13)	−452	40	18	12.0	12.0	...	...	...	...	...
Al–4.4Mg–Mn	B209	5083	A95083	H32	0.188–1.500	25	(13) (33)	−452	44	31	14.7	14.7	...	...	...	...	...
Al–4.0Mg–Mn	B209	5086	A95086	O	...	25	...	−452	35	14	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B209	5086	A95086	H112	0.500–1.000	25	(13) (33)	−452	35	16	9.3	9.3	...	...	...	...	...
Al–4.0Mg–Mn	B209	5086	A95086	H32	...	25	(33)	−452	40	28	13.3	13.3	...	...	...	...	...
Al–4.0Mg–Mn	B209	5086	A95086	H34	...	25	(33)	−452	44	34	14.7	14.7	...	...	...	...	...
Al–3.5Mg	B209	5154	A95154	O	...	22	...	−452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B209	5154	A95154	H112	0.500–3.000	22	(13) (33)	−452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B209	5154	A95154	H32	...	22	(33)	−452	36	26	12.0	12.0	...	...	...	...	...
Al–3.5Mg	B209	5154	A95154	H34	...	22	(33)	−452	39	29	13.0	13.0	...	...	...	...	...

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Plates and Sheets (Cont'd)																	
Al–3.5Mg	B209	5254	A95254	O	...	22	...	−452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B209	5254	A95254	H112	0.500–3.000	22	(13) (33)	−452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B209	5254	A95254	H32	...	22	(33)	−452	36	26	12.0	12.0	...	...	...	...	...
Al–3.5Mg	B209	5254	A95254	H34	...	22	(33)	−452	39	29	13.0	13.0	...	...	...	...	...
Al–2.7Mg–Mn	B209	5454	A95454	O	...	22	...	−452	31	12	8.0	8.0	8.0	7.4	5.5	4.1	3.0
Al–2.7Mg–Mn	B209	5454	A95454	H112	0.500–3.000	22	(13) (33)	−452	31	12	8.0	8.0	8.0	7.4	5.5	4.1	3.0
Al–2.7Mg–Mn	B209	5454	A95454	H32	...	22	(33)	−452	36	26	12.0	12.0	12.0	7.5	5.5	4.1	3.0
Al–2.7Mg–Mn	B209	5454	A95454	H34	...	22	(33)	−452	39	29	13.0	13.0	13.0	7.5	5.5	4.1	3.0
Al–5.1Mg–Mn	B209	5456	A95456	O	0.051–1.500	25	(13)	−452	42	19	12.7	12.7	...	...	...	...	...
Al–5.1Mg–Mn	B209	5456	A95456	H32	0.188–0.499	25	(13) (33)	−452	46	33	15.3	15.3	...	...	...	...	...
Al–2.5Mg	B209	5652	A95652	O	...	22	...	−452	25	9.5	6.3	6.3	6.3	6.2	6.1	4.1	2.3
Al–2.5Mg	B209	5652	A95652	H112	0.500–3.000	22	(13) (33)	−452	25	9.5	6.3	6.3	6.3	6.3	6.1	4.1	2.3
Al–2.5Mg	B209	5652	A95652	H32	...	22	(33)	−452	31	23	10.3	10.3	10.3	10.3	6.1	4.1	2.3
Al–2.5Mg	B209	5652	A95652	H34	...	22	(33)	−452	34	26	11.3	11.3	11.3	11.3	6.1	4.1	2.3
Al–Mg–Si–Cu	B209	6061	A96061	T4 wld.	...	23	(22) (63)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B209	6061	A96061	T6 wld.	...	23	(22) (63)	−452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B209	6061	A96061	T4	...	23	(33) (63)	−452	30	16	10.0	10.0	10.0	9.9	9.5	8.4	5.2
Al–Mg–Si–Cu	B209	6061	A96061	T6	...	23	(33)	−452	42	35	14.0	14.0	14.0	13.6	11.7	8.9	5.2
Al–Mg–Si–Cu	B209	6061	A96061	T651	0.250–4.000	23	(13) (33)	−452	42	35	14.0	14.0	14.0	13.6	11.7	8.9	5.2
Aluminum Alloy — Forgings and Fittings																	
Al–Mn–Cu	B361	WP Alclad 3003	A83003	O	...	21	(13) (14) (32) (33) (66)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
Al–Mn–Cu	B361	WP Alclad 3003	A83003	H112	...	21	(13) (14) (32) (33) (66)	−452	13	4.5	3.0	2.9	2.8	2.7	2.5	1.9	1.5
99.60Al	B361	WP1060	A91060	O	...	21	(13) (14) (32) (33)	−452	8	2.5	1.7	1.6	1.6	1.4	1.2	1.1	0.8
99.60Al	B361	WP1060	A91060	H112	...	21	(13) (14) (32) (33)	−452	8	2.5	1.7	1.6	1.6	1.4	1.2	1.1	0.8
99.0Al–Cu	B361	WP1100	A91100	O	...	21	(13) (14) (32) (33)	−452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
99.0Al–Cu	B361	WP1100	A91100	H112	...	21	(13) (14) (32) (33)	−452	11	3	2.0	2.0	2.0	1.9	1.7	1.3	1.0
Al–Mn–Cu	B247	3003	A93003	H112	...	21	(9) (45)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B247	3003	A93003	H112 wld.	...	21	(9) (45)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B361	WP3003	A93003	O	...	21	(13) (14) (32) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B361	WP3003	A93003	H112	...	21	(13) (14) (32) (33)	−452	14	5	3.3	3.2	3.1	3.0	2.7	1.9	1.5
Al–Mn–Cu	B247	5083	A95083	O	...	25	(9) (32) (33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–Mn–Cu	B247	5083	A95083	H112	...	25	(9) (32) (33)	−452	39	16	10.7	10.7	...	...	...	...	...
Al–Mn–Cu	B247	5083	A95083	H112 wld.	...	25	(9) (32) (33)	−452	39	16	10.7	10.7	...	...	...	...	...

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

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Nominal Composition	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size or Thickness Range, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, *S*, ksi, at Metal Temperature, °F [Notes (1), (4a)]						
									Tensile	Yield	Min. Temp. to 100	150	200	250	300	350	400
Aluminum Alloy — Forgings and Fittings (Cont'd)																	
Al–4.4Mg–Mn	B361	WP5083	A95083	O	...	25	(13) (32) (33)	–452	39	16	10.7	10.7	...	...	...	...	...
Al–4.4Mg–Mn	B361	WP5083	A95083	H112	...	25	(13) (32) (33)	–452	39	16	10.7	10.7	...	...	...	...	...
Al–3.5Mg	B361	WP5154	A95154	O	...	22	(32) (33)	–452	30	11	7.3	7.3	...	...	...	...	...
Al–3.5Mg	B361	WP5154	A95154	H112	...	22	(32) (33)	–452	30	11	7.3	7.3	...	...	...	...	...
Al–Mg–Si–Cu	B247	6061	A96061	T6 wld.	...	23	(9) (22)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B361	WP6061	A96061	T4 wld.	...	23	(22) (32) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B361	WP6061	A96061	T6 wld.	...	23	(22) (32) (63)	–452	24	...	8.0	8.0	8.0	8.0	7.7	6.9	5.1
Al–Mg–Si–Cu	B361	WP6061	A96061	T4	...	23	(13) (32) (33) (63)	–452	26	16	8.7	8.7	8.7	8.7	8.3	7.4	5.2
Al–Mg–Si–Cu	B247	6061	A96061	T6	...	23	(9) (33)	–452	38	35	12.7	12.7	12.7	12.3	10.5	8.1	5.2
Al–Mg–Si–Cu	B361	WP6061	A96061	T6	...	23	(13) (32) (33) (63)	–452	38	35	12.7	12.7	12.7	12.3	10.5	8.1	5.2
Al–Mg–Si	B361	WP6063	A96063	T4 wld.	...	23	(32)	–452	17	...	5.7	5.7	5.7	5.7	5.5	3.8	2.0
Al–Mg–Si	B361	WP6063	A96063	T6 wld.	...	23	(32)	–452	17	...	5.7	5.7	5.7	5.7	5.5	3.8	2.0
Al–Mg–Si	B361	WP6063	A96063	T4	...	23	(13) (32) (33)	–452	18	9	6.0	5.9	5.8	5.7	5.5	3.7	1.4
Al–Mg–Si	B361	WP6063	A96063	T6	...	23	(13) (32) (33)	–452	30	25	10.0	10.0	10.0	9.1	7.2	3.4	2.0
Aluminum Alloy — Castings																	
Al–Si–Mg	B26	356.0	A03560	T71	...	26	(9) (43)	–452	25	18	8.3	8.3	8.3	8.1	7.3	5.5	2.4
Al–Si–Mg	B26	356.0	A03560	T6	...	26	(9) (43)	–452	30	20	10.0	10.0	10.0	8.4	...	...	...
Al–Si	B26	443.0	A04430	F	...	...	(9) (43)	–452	17	7	4.7	4.7	4.7	4.7	4.7	4.7	3.5