

**Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm <sup>2</sup> or MPa	ksi	N/mm <sup>2</sup> or MPa	ksi		
ASTM A 214/A 214M-96 (2001)	---	---	K01807	see standard	---	---	---	---	---	---	---	72 HRB max
ASTM A 556/A 556M-96 (2001)	A2	---	K01807	---	---	---	180	26	320	47	35	72 HRB max
EN 10216-2:2002	P195GH	1.0348	---	N, NF	≤ 16	---	195	---	320-440	---	27 L; 25 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	---	---				
					40 < t ≤ 60	---	---	---				
EN 10217-2:2002	P195GH	1.0348	---	see standard	≤ 16	---	195	---	320-440	---	27 L; 25 T	see standard
ISO 2604-II:1975	TS 1	---	---	HF, SCA, A, N	---	---	195	---	320-440	---	25	---
	TS 2	---	---	HF, N	---	---	195	---	320-440	---	25	---
ISO 2604-III:1975	TW 1	---	---	W, HR, SCA, A, N	---	---	195	---	320-440	---	25	---
	TW 2	---	---	N	---	---	195	---	320-440	---	25	---
ASTM A 178/A 178M-02*	A	---	K01200	see standard	---	---	180	26	325	47	35	---
ASTM A 179/A 179M-90a (2001)*	---	---	K01200	CD+1200°F min	---	---	180	26	325	47	35	72 HRB max
ASTM A 192/A 192M-02*	---	---	K01201	HF or CF + 1200°F min	---	---	180	26	325	47	35	5.1 mm (0.200 in) 137 HB max 77 HRB max
ASTM A 106-02a	A	---	K02501	HF or CD + 1200°F min	---	---	205	30	330	48	35 L; 25 T	---
JIS G 3461:1988	STB 340	---	---	see standard	---	---	175	---	340	---	35	---
DIN 28180:1985	TTSSt 35 N	1.0356	---	N	≤ 10	---	225	---	340-460	---	25 L; 23 T	L:40 J at -40°C
DIN 28181:1985	TTSSt 35 N	1.0356	---	N or NG	≤ 10	---	225	---	340-460	---	25 L; 23 T	40 J at -40°C

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Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm <sup>2</sup> or MPa	ksi	N/mm <sup>2</sup> or MPa	ksi		
DIN 1630:1984	St 37.4	1.0255	---	AD	≤ 16	---	235	---	350-480	---	25 L; 23 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	225	---				
					> 40	---	215	---				
DIN 28180:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
					40 < t ≤ 65	---	215	---	350-480	---	25 L; 23 T	---
DIN 28181:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
					40 < t ≤ 65	---	215	---	350-480	---	25 L; 23 T	---
ISO 2604-II:1975	TS 4	---	---	HF, SCA, A, N	---	---	215	---	360-480	---	24	---
	TS 5	---	---	HF, N	---	---	215	---	360-480	---	24	---
	TS 6	---	---	HF, A, N	---	---	215	---	360-480	---	24	---
ISO 2604-III:1975	TW 4	---	---	W, HR, SCA, A, N	---	---	215	---	360-480	---	24	---
	TW 5	---	---	N	---	---	215	---	360-480	---	24	---
	TW 6	---	---	A, N	---	---	215	---	360-480	---	24	---
AFNOR NF A 49-220:1990	TU 37 C	---	---	N	---	---	220	---	360-460	---	---	32 J at 0°C
DIN 28180:1985	St 35.8	1.0305	---	N	≤ 16	---	235	---	360-480	---	25 L; 23 T	T: 34 J at RT
					16 < t ≤ 40	---	225	---	360-480	---	25 L; 23 T	T: 34 J at RT
					40 < t ≤ 60	---	215	---	360-480	---	25 L; 23 T	T: 34 J at RT
DIN 28181:1985	St 37.8	1.0315	---	AD	≤ 16	---	235	---	360-480	---	25 L; 23 T	---
DIN 28180:1985	TTSt 35 N	1.0356	---	V (QT)	≤ 25	---	255	---	360-490	---	23 L; 21 T	L:45 J at -40°C T:30 J at -40°C
					25 < t ≤ 40	---	235	---	360-490	---	23 L; 21 T	L:40 J at -40°C T:27 J at -40°C
EN 10216-2:2002	P235GH	1.0345	---	N, NF	≤ 16	---	235	---	360-500	---	25 L; 23 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 60	---	215	---				
EN 10217-2:2002	P235GH	1.0345	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
EN 10217-5:2002	P235GH	1.0345	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
					16 < t ≤ 40	---	225	---				
JIS G 3455:1988	STS 370	---	---	HFS: AM CFS: LTA or N	---	---	215	---	370	---	30	---
JIS G 3456:1988	STPT 370	---	---	see standard	---	---	215	---	370	---	30	---

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Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm <sup>2</sup> or MPa	ksi	N/mm <sup>2</sup> or MPa	ksi		
AFNOR NF A 49-220:1990	TU 42 C	---	---	N	---	---	235	---	410-510	---	---	32 J at 0°C
ISO 2604-II:1975	TS 9	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 9H	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 10	---	---	HF, A, N	---	---	235	---	410-530	---	22	---
ISO 2604-III:1975	TW 9	---	---	W, HR, SCA, A, N	---	---	235	---	410-530	---	22	---
	TW 9H	---	---	N	---	---	235	---	410-530	---	22	---
	TW 10	---	---	A, N	---	---	235	---	410-530	---	22	---
JIS G 3455:1988	STS 410	---	---	HFS: AM CFS: LTA or N	---	---	245	---	410	---	25	---
JIS G 3456:1988	STPT 410	---	---	see standard	---	---	245	---	410	---	25	---
JIS G 3467:1988	STF 410	---	---	HFS: AM CFS: LTA, N	---	---	245	---	410	---	25	---
JIS G 3461:1988	STB 410	---	---	see standard	---	---	255	---	410	---	25	---
ASTM A 556/A 556M-96 (2001)	B2	---	K02707	CD+1200°F min	---	---	260	37	410	60	30	79 HRB max
EN 10216-2:2002	P265GH	1.0425	---	N, NF	≤ 16	---	265	---	410-570	---	23 L; 21 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	255	---				
					40 < t ≤ 60	---	245	---				
EN 10217-2:2002	P265GH	1.0425	---	see standard	≤ 16	---	265	---	410-570	---	23 L; 21 T	see standard
EN 10217-5:2002	P265GH	1.0425	---	see standard	≤ 16	---	265	---	410-570	---	23 L; 21 T	see standard
					16 < t ≤ 40	---	255	---				
ASTM A 106-02a	B	---	K03006	HF or CD + 1200°F min	---	---	240	35	415	60	30 L; 16.5 T	---
ASTM A 178/A 178M-02*	C	---	K03503	see standard	---	---	255	37	415	60	30	---
ASTM A 210/A 210M-02	A-1	---	K02707	HF or CF + SA, A, N	---	---	255	37	415	60	30	79 HRB max 143 HB max
DIN 1630:1984	St 44.4	1.0257	---	AD	≤ 16	---	275	---	420-550	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				

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Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm <sup>2</sup> or MPa	ksi	N/mm <sup>2</sup> or MPa	ksi		
AFNOR NF A 49-220:1990	TU 48 C	---	---	N	---	---	275	---	470-570	---	---	40 J at 0°C
JIS G 3455:1988	STS 480	---	---	LTA or N	---	---	275	---	480	---	25	---
JIS G 3456:1988	STPT 480	---	---	see standard	---	---	275	---	480	---	25	---
ISO 2604-II:1975	TS 13	---	---	HF, SCA, A, N	---	---	265	---	460-580	---	21	---
	TS 14	---	---	HF, N	---	---	265	---	460-580	---	21	---
	TS 15	---	---	HF, A, N	---	---	265	---	460-580	---	21	---
ISO 2604-III:1975	TW 13	---	---	W, HR, SCA, A, N	---	---	265	---	460-580	---	21	---
	TW 14	---	---	N	---	---	265	---	460-580	---	21	---
	TW 15	---	---	A, N	---	---	265	---	460-580	---	21	---
ASTM A 556/A 556M-26 (2001)	C2	---	K03006	CD+1200°F min	---	---	280	40	480	70	30	89 HRB max
ASTM A 178/A 178M-02*	D	---	---	see standard	---	---	275	40	485	70	30	---
ASTM A 210/A 210M-02	C	---	K03501	HF or CF + SA, A, N	---	---	275	40	485	70	30	89 HRB max 179 HB max
ISO 2604-II:1975	TS 18	---	---	HF, N	---	---	285	---	490-610	---	21	---
ASTM A 106-02a	C	---	K03501	HF or CD + 1200°F min	---	---	275	40	485	70	30 L; 16.5 T	---
DIN 1630:1984	St 52.4	1.0581	---	AD	≤ 16	---	355	---	500-650	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	345	--				
					40 < t ≤ 65	---	335	---				
JIS G 3461:1988	STB 510	---	---	N	---	---	295	---	510	---	25	---
AFNOR NF A 49-220:1990	TU 52 C	---	---	N	---	---	350	---	510-630	---	---	40 J at 0°C

**Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified									Others
				C	Mn	Si	P	S	Cr	Ni	Mo		
ASTM A 214/A 214M-96 (2001)	---	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---	
ASTM A 556/A 556M-96 (2001)	A2	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---	
EN 10216-2:2002	P195GH	1.0348	---	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70	
EN 10217-2:2002	P195GH	1.0348	---	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; Cr+Cu+Mo+Ni 0.70	
ISO 2604-II:1975	TS 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---	
	TS 2	---	---	0.16	0.40-0.70	---	0.050	0.050	---	---	---	---	
ISO 2604-III:1975	TW 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---	
	TW 2	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---	
ASTM A 178/A 178M-02*	A	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---	
ASTM A 179/A 179M-90a (2001)*	---	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---	
ASTM A 192/A 192M-02*	---	---	K01201	0.06-0.18	0.27-0.63	0.25	0.035	0.035	---	---	---	---	
ASTM A 106-02a	A	---	K02501	0.25	0.27-0.93	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0	
JIS G 3461:1988	STB 340	---	---	0.18	0.30-0.60	0.35	0.035	0.035	---	---	---	---	
DIN 28180:1985	TTS 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	---	
DIN 28181:1985	TT St 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	Al 0.020 min	
DIN 1630:1984	St 37.4	1.0255	---	0.17	≥ 0.35	0.35	0.040	0.040	---	---	---	N fixing elements	
DIN 28180:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009	
DIN 28181:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009	
ISO 2604-II:1975	TS 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---	
	TS 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---	
	TS 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015	
ISO 2604-III:1975	TW 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---	
	TW 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---	
	TW 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015	
AFNOR NF A 49-220:1990	TU 37 C	---	---	0.16	0.35-0.75	0.06-0.30	0.025	0.025	---	---	---	---	
DIN 28180:1985	St 35.8	1.0305	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---	
DIN 28181:1985	St 37.8	1.0315	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---	
DIN 28180:1985	TTS 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	Al 0.020 min	
EN 10216-2:2002	P235GH	1.0345	---	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70	
EN 10217-2:2002	P235GH	1.0345	---	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; Cr+Cu+Mo+Ni 0.70	
EN 10217-5:2002	P235GH	1.0345	---	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; Cr+Cu+Mo+Ni 0.70	
JIS G 3455:1988	STS 370	---	---	0.25	0.30-1.10	0.10-0.35	0.035	0.035	---	---	---	---	
JIS G 3456:1988	STPT 370	---	---	0.25	0.30-0.90	0.10-0.35	0.035	0.035	---	---	---	---	

**Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 42 C	---	---	0.20	0.45-1.00	0.08-0.35	0.025	0.025	---	---	---	---
ISO 2604-II:1975	TS 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
JIS G 3455:1988	STS 410	---	---	0.30	0.30-1.40	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3467:1988	STF 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3461:1988	STB 410	---	---	0.32	0.30-0.80	0.35	0.035	0.035	---	---	---	---
ASTM A 556/A 556M-96 (2001)	B2	---	K02707	0.27	0.29-0.93	0.10	0.035	0.035	---	---	---	---
EN 10216-2:2002	P265GH	1.0425	---	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70
EN 10217-2:2002	P265GH	1.0425	---	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; Cr+Cu+Mo+Ni 0.70
EN 10217-5:2002	P265GH	1.0425	---	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; Cr+Cu+Mo+Ni 0.70
ASTM A 106-02a	B	---	K03006	0.30	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
ASTM A 178/A 178M-02*	C	---	K03503	0.35	0.80	---	0.035	0.035	---	---	---	---
ASTM A 210/A 210M-02	A-1	---	K02707	0.27	0.93	0.10	0.035	0.035	---	---	---	---
DIN 1630:1984	St 44.4	1.0257	---	0.20	≥ 0.40	0.35	0.040	0.040	---	---	---	N fixing elements

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**Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 48 C	---	---	0.22	0.65-1.25	0.10-0.35	0.025	0.025	---	---	---	---
JIS G 3455:1988	STS 480	---	---	0.33	0.30-1.50	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 480	---	---	0.33	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
ISO 2604-II:1975	TS 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TS 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TS 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TW 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TW 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
ASTM A 556/A 556M-96 (2001)	C2	---	K03006	0.30	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ASTM A 178/A 178M-02*	D	---	---	0.27	1.00-1.50	0.10 min	0.030	0.015	---	---	---	---
ASTM A 210/A 210M-02	C	---	K03501	0.35	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ISO 2604-II:1975	TS 18	---	---	0.23	0.80-1.50	0.35	0.045	0.045	---	---	---	---
ASTM A 106-02a	C	---	K03501	0.35	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
DIN 1630:1984	St 52.4	1.0581	---	0.22	1.60	0.55	0.040	0.035	---	---	---	N fixing elements
JIS G 3461:1988	STB 510	---	---	0.25	1.00-1.50	0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-220:1990	TU 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.025	0.025	---	---	---	---