

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 1/4Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	0.12-0.20	0.50-0.80	0.15-0.35	0.025	0.025	0.30	---	0.25-0.35	---
DIN 28180:1985	15 Mo 3	1.5415	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	---
EN 10216-2:2002	16Mo3	1.5415	---	0.12-0.20	0.40-0.90	0.35	0.025	0.020	0.30	0.30	0.25-0.35	Al 0.040; Cu 0.30
EN 10217-2:2002	16Mo3	1.5415	---	0.12-0.20	0.40-0.90	0.35	0.025	0.020	0.30	0.30	0.25-0.35	Cu 0.30; Al 0.040
EN 10217-5:2002	16Mo3	1.5415	---	0.12-0.20	0.40-0.90	0.35	0.025	0.020	0.30	0.30	0.25-0.35	Cu 0.30; Al 0.040
ISO 2604-II:1975	TS 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012
ISO 2604-III:1975	TW 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012

Mechanical Properties of 1/4Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	heat + air cool	---	---	265	---	430-550	---	22	---
DIN 28180:1985	15 Mo 3	1.5415	---	see standard	≤ 16	---	270	---	450-600	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	270	---	450-600	---	22 L; 20 T	
					40 < t ≤ 60	---	260	---	450-600	---	22 L; 20 T	
EN 10216-2:2002	16Mo3	1.5415	---	N, NF	≤ 16	---	280	---	450-600	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	270	---				
					40 < t ≤ 60	---	260	---				
EN 10217-2:2002	16Mo3	1.5415	---	see standard	≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard for impact data
EN 10217-5:2002	16Mo3	1.5415	---	see standard	≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard for impact data
					16 < t ≤ 40	---	270	---				
ISO 2604-II:1975	TS 26	---	---	N, NT	---	---	250	---	450-600	---	22	---
ISO 2604-III:1975	TW 26	---	---	N, NT	---	---	250	---	450-600	---	22	---

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 1/2Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 209/A 209M-03	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 250/A 250M-95 (2001)	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 335/A 335M-03	P1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
JIS G 3458:1988	STPA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:1988	STBA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3467:1988	STFA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:1988	STBA 13	---	---	0.15-0.25	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
EN 10216-2:2002	8MoB5-4	1.5450	---	0.06-0.10	0.60-0.80	0.10-0.35	0.025	0.020	0.20	---	0.40-0.50	Al 0.060; Cu 0.30; Ti 0.060; B 0.002-0.006

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Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Mechanical Properties of ½Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 209/A 209M-03	T1	---	K11522	see standard	< 5.1	< 0.200	205	30	380	55	30	80 HRB max
					≥ 5.1	≥ 0.200						146 HB max
	T1a	---	K12023	see standard	< 5.1	< 0.200	220	32	415	60	30	81 HRB max
					≥ 5.1	≥ 0.200						153 HB max
	T1b	---	K11422	see standard	< 5.1	< 0.200	195	28	365	53	30	77 HRB max
					≥ 5.1	≥ 0.200						137 HB max
ASTM A 250/A 250M-95 (2001)	T1	---	K11522	A, IA, N or NT	---	---	205	30	380	55	30	146 HB max 80 HRB max
	T1a	---	K12023	A, IA, N or NT	---	---	220	32	415	60	30	153 HB max 81 HRB max
	T1b	---	K11422	A, IA, N or NT	---	---	195	28	365	53	30	137 HB max 77 HRB max
ASTM A 335/A 335M-03	P1	---	K11522	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 12	---	---	LTA, IA, FA, N, or NT	---	---	205	---	380 min	---	30	---
JIS G 3462:1988	STBA 12	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	380	---	---	22
					10 ≤ O.D. < 20	---						25
					O.D. ≥ 20	---						30
JIS G 3467:1988	STFA 12	---	---	LTA, IA, A, N or NT	---	---	205	---	380	---	30	---
JIS G 3462:1988	STBA 13	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	410	---	---	22
					10 ≤ O.D. < 20	---						25
					O.D. ≥ 20	---						30
EN 10216-2:2002	8MoB5-4	1.5450	---	N, NF	≤ 16	---	400	---	540-690	---	19 L; 17 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	---					
					40 < t ≤ 60	---	---					

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of ½Cr-½Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
ASTM A 250/A 250M-95 (2001)	T2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.020	0.50-0.81	---	0.44-0.65	---
ASTM A 335/A 335M-03	P2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	0.10-0.18	0.50-0.90	0.10-0.35	0.025	0.025	0.40-0.65	---	0.45-0.60	---
JIS G 3458:1988	STPA 20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
JIS G 3462:1988	STBA 20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
ISO 2604-II:1975	TS 33	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.30-0.60	---	0.50-0.70	Al 0.02; V 0.22-0.32
EN 10216-2:2002	14MoV6-3	1.7715	---	0.10-0.15	0.40-0.70	0.15-0.35	0.025	0.020	0.30-0.60	0.30	0.50-0.70	Al 0.040; Cu 0.30; V 0.22-0.28

Mechanical Properties of ½Cr-½Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-03a	T2	---	K11547	A, IA, NT, SA	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T2	---	K11547	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P2	---	K11547	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5/16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	heat + air cool + T	---	---	275	---	440-570	---	22	32 J at 0°C
JIS G 3458:1988	STPA 20	---	---	LTA, IA, FA, or NT	---	---	205	---	410 min	---	30	---
JIS G 3462:1988	STBA 20	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
ISO 2604-II:1975	TS 33	---	---	NT	---	---	275	---	460-610	---	15	---
EN 10216-2:2002	14MoV6-3	1.7715	---	NT, NF, QT	≤ 16	---	320	---	460-610	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	320					
					40 < t ≤ 60	---	310					

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 1Cr-½Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
ASTM A 250/A 250M-95 (2001)	T12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.030	0.020	0.80-1.25	---	0.44-0.65	---
ASTM A 335/A 335M-03	P12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
AFNOR NF A 49-220:1990	TU 13 CD 4-04	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.025	0.025	0.70-1.10	---	0.45-0.65	---
BS 3604-2:1991	620	---	---	0.09-0.18	0.40-0.65	0.15-0.40	0.025	0.015	0.80-1.15	0.30	0.45-0.60	Cu 0.30; Al 0.02
JIS G 3458:1988	STPA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3462:1988	STBA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3467:1988	STFA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
DIN 28180:1985	13 CrMo 4 4	1.7335	---	0.10-0.18	0.40-0.70	0.10-0.35	0.035	0.035	0.70-1.10	---	0.45-0.65	---
EN 10216-2:2002	13CrMo4-5	1.7335	---	0.10-0.17	0.40-0.70	0.35	0.025	0.020	0.70-1.15	0.30	0.40-0.60	Al 0.040; Cu 0.30
ISO 2604-II:1975	TS 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.02
ISO 2604-III:1975	TW 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.020

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Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Mechanical Properties of 1Cr-½Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-03a	T12	---	K11562	A, IA, NT, SA	---	---	220	32	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T12	---	K11562	A, IA, N or NT	---	---	220	32	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P12	---	K11562	FA, IA or NT	---	---	220	32	415	60	≥ 8mm (⁵ / ₁₆ in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 13 CD 4-04	---	---	heat + air cool + T	---	---	290	---	440-590	---	22	32 J at 0°C
BS 3604-2:1991	620	---	---	see standard	---	---	340	---	480-600	---	18	---
JIS G 3458:1988	STPA 22	---	---	LTA, IA, FA, or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 22	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 22	---	---	LTA, IA, A or NT	---	---	205	---	410	---	30	---
DIN 28180:1985	13 CrMo 4 4	1.7335	---	see standard	≤ 16	---	290	---	440-590	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	290	---	440-590	22 L; 20 T		
					40 < t ≤ 60	---	280	---	440-590	22 L; 20 T		
EN 10216-2:2002	13CrMo4-5	1.7335	---	NT, NF, QT	≤ 16	---	290	---	440-590	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	290	---				
					40 < t ≤ 60	---	280	---				
ISO 2604-II:1975	TS 32	---	---	NT	---	---	275	---	440-590	---	22	---
ISO 2604-III:1975	TW 32	---	---	NT	---	---	275	---	440-590	---	22	---

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 1¼Cr-½Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.44-0.65	---
ASTM A 250/A 250M-95 (2001)	T11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	---	0.44-0.65	---
ASTM A 335/A 335M-03	P11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
BS 3604-2:1991	621	---	---	0.09-0.17	0.40-0.65	0.50-0.80	0.025	0.015	1.00-1.50	0.30	0.45-0.60	Cu 0.30; Al 0.02
EN 10216-2:2002	10CrMo5-5	1.7338	---	0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	0.30	0.45-0.65	Al 0.040; Cu 0.30
JIS G 3462:1988	STBA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3467:1988	STFA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3458:1988	STPA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---

Mechanical Properties of 1¼Cr-½Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-03a	T11	---	K11597	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T11	---	K11597	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P11	---	K11597	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	see standard	---	---	225	---	440-590	---	22	---
				heat + air cool + T	---	---	325	---	440-640	---	20	32 J at 0°C
BS 3604-2:1991	621	---	---	see standard	---	---	340	---	515-690	---	18	---
EN 10216-2:2002	10CrMo5-5	1.7338	---	NT, NF, QT	≤ 16	---	275	---	410-560	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	275	---				
					40 < t ≤ 60	---	265	---				
JIS G 3462:1988	STBA 23	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---						
					O.D. ≥ 20	---						
JIS G 3467:1988	STFA 23	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
JIS G 3458:1988	STPA 23	---	---	IA, FA or NT	---	---	205	---	410	---	30	---

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 2¼-1Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T22	---	K21590	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
ASTM A 250/A 250M-95 (2001)	T22	---	K21590	0.15	0.30-0.60	0.50	0.025	0.020	1.90-2.60	---	0.87-1.13	---
ASTM A 335/A 335M-03	P22	---	K21590	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	0.15	0.30-0.60	0.10-0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
BS 3604-2:1991	622	---	---	0.09-0.15	0.30-0.60	0.50	0.025	0.015	2.00-2.50	0.30	0.90-1.10	Cu 0.30; Al 0.02
EN 10216-2:2002	10CrMo9-10	1.7380	---	0.08-0.14	0.30-0.70	0.50	0.025	0.020	2.00-2.50	0.30	0.90-1.10	Al 0.040; Cu 0.30
	11CrMo9-10	1.7383	---	0.08-0.15	0.40-0.80	0.50	0.025	0.020	2.00-2.50	0.30	0.90-1.10	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3462:1988	STBA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3467:1988	STFA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
ISO 2604-II:1975	TS 34	---	---	0.08-0.15	0.40-0.70	0.50	0.040	0.040	2.00-2.50	---	0.90-1.20	Al 0.02

Mechanical Properties of 2¼-1Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-03a	T22	---	K21590	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T22	---	K21590	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P22	---	K21590	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	see standard	---	---	225	---	410-560	---	22	---
				heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
BS 3604-2:1991	622	---	---	see standard	---	---	310	---	515-690	---	16	---
EN 10216-2:2002	10CrMo9-10	1.7380	---	NT, NF, QT	≤ 16	---	280	---	480-630	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	280	---				
					40 < t ≤ 60	---	270	---				
	11CrMo9-10	1.7383	---	QT	≤ 16	---	355	---	540-680	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
JIS G 3462:1988	STBA 24	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3458:1988	STPA 24	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
ISO 2604-II:1975	TS 34	---	---	A	---	---	135	---	410-560	---	20	---

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 5Cr-½Mo Alloy 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								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
	T5b	---	K51545	0.15	0.30-0.60	1.00-2.00	0.025	0.025	4.00-6.00	---	0.45-0.65	---
ASTM A 335/A 335M-03	P5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
EN 10216-2:2002	X11CrMo5+I	1.7362+I	---	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.020	4.00-6.00	---	0.45-0.65	Al 0.040; Cu 0.30
	X11CrMo5+NT1	1.7362+NT1	---	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.020	4.00-6.00	---	0.45-0.65	Al 0.040; Cu 0.30
	X11CrMo5+NT2	1.7362+NT2	---	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.020	4.00-6.00	---	0.45-0.65	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3462:1988	STBA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3467:1988	STFA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ISO 2604-II:1975	TS 37	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Al 0.02

Mechanical Properties of 5Cr-½Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi			
ASTM A 213/A 213M-03a	T5	---	K41545	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max	
	T5b	---	K51545	A, IA, NT	---	---	205	30	415	60	30	179 HB max 89 HRB max	
ASTM A 335/A 335M-03	P5	---	K41545	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---	
EN 10216-2:2002	X11CrMo5+I	1.7362+I	---	I	≤ 16	---	175	---	430-580	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C	
					16 < t ≤ 40	---	175	---					
					40 < t ≤ 60	---	175	---					
					60 < t ≤ 100	---	175	---					
	X11CrMo5+NT1	1.7362+NT1	---	---	NT	≤ 16	---	280	---	480-640	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
						16 < t ≤ 40	---	280	---				
						40 < t ≤ 60	---	280	---				
						60 < t ≤ 100	---	280	---				
	X11CrMo5+NT2	1.7362+NT2	---	---	NT, QT	≤ 16	---	390	---	570-740	---	18 L; 16 T	L: 40 J at 20°C T: 27 J at 20°C
						16 < t ≤ 40	---	390	---				
						40 < t ≤ 60	---	390	---				
						60 < t ≤ 100	---	390	---				
JIS G 3458:1988	STPA 25	---	---	IA, FA or NT	---	---	205	---	410	---	30	---	
JIS G 3462:1988	STBA 25	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---	
					10 ≤ O.D. < 20	---					25		
					O.D. ≥ 20	---					30		
JIS G 3467:1988	STFA 25	---	---	IA, A, or NT	---	---	205	---	410	---	30	---	
ISO 2604-II:1975	TS 37	---	---	A	---	---	205	---	410-560	---	20	---	

Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Chemical Composition of 9Cr-1Mo Alloy 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 213/A 213M-03a	T9	---	S50400	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
ASTM A 335/A 335M-03	P9	---	S50400	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
EN 10216-2:2002	X11CrMo9-1+I	1.7386+I	---	0.08-0.15	0.30-0.60	0.25-1.00	0.025	0.020	8.00-10.00	---	0.90-1.10	Al 0.040; Cu 0.30
	X11CrMo9-1+NT	1.7386+NT	---	0.08-0.15	0.30-0.60	0.25-1.00	0.025	0.020	8.00-10.00	---	0.90-1.10	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3462:1988	STBA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3467:1988	STFA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
ISO 2604-II:1975	TS 38	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.02
ASTM A 213/A 213M-03a	T91	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Cb 0.06-0.1; N 0.030-0.070; Al 0.04
EN 10216-2:2002	X10CrMoVNb9-1	1.4903	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Nb 0.06-0.10; N 0.030-0.070; Al 0.040; Cu 0.30

Mechanical Properties of 9Cr-1Mo Alloy 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 ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-03a	T9	---	S50400	A, IA, NT	---	---	205	30	415	60	30	179 HB max 89 HRB max
ASTM A 335/A 335M-03	P9	---	S50400	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
EN 10216-2:2002	X11CrMo9-1+I	1.7386+I	---	I	≤ 16	---	210	---	460-640	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	210	---				
	X11CrMo9-1+NT	1.7386+NT	---	NT, QT	40 < t ≤ 60	---	210	---	590-740	---	18 L; 16 T	L: 40 J at 20°C T: 27 J at 20°C
					≤ 16	---	390	---				
JIS G 3458:1988	STPA 26	---	---	IA, FA or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 26	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 26	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
ISO 2604-II:1975	TS 38	---	---	A	---	---	135	---	410-560	---	20	---
ASTM A 213/A 213M-03a	T91	---	---	NT	---	---	415	60	585	85	20	250 HB max 25 HRC max
EN 10216-2:2002	X10CrMoVNb9-1	1.4903	---	NT, QT	≤ 16	---	450	---	630-830	---	19 L; 17 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	450	---				
					40 < t ≤ 60	---	450	---				