Alloy steel tubes for high-temperature service

Material Data Sheet

Steel designation:	Name	Material No.
	P22/T22	**UNS Designation: K21590**
	(10CrMo9-10)	**(1.7380)**

Scope

This data sheet applies for seamless tubes.

Application

The material P22/T22 is especially suited for steam boiler, boiler parts, boiler drum, pressure vessel for the apparatus engineering and similar purposes. It can be used in permanent operation with wall temperatures up to about 590 °C (1094 °F).

Chemical composition (Heat analysis in %)

Name	C	Si	Mn	P	S	$Al_{ges.}$	Cu	Cr	Mo
P22/T22	0,05-0,15	≤ 0,50	0,30-0,60	≤ 0,025	≤ 0,025	-	-	1,9-2,6	0,87-1,13
10CrMo9-10	0,08-0,14	≤ 0,50	0,30-0,70	≤ 0,025	≤ 0,020	≤ 0,040	≤ 0,30	2,00-2,50	0,90-1,10

Mechanical properties at room temperature

Material	Usual[1] Delivery condition	Product thickness mm	Yield/ proof strength $R_{eH}/R_{p0,2}$ N/mm² min.	Tensile strength R_m N/mm²	Elongation A % min.		Impact energy KV Temperature °C	Impact energy KV J min.	
P22/T22[5]	+NT	-	205	415	30[2)4)]	20[3)4)]	-	-	
10CrMo9-10	+NT	≤16	280	480-630	22[2)]	20[3)]	+20	40[2)]	27[3)]
		16≤40	280						
		40≤60	270						

1) NT: normalized and tempered; QT: quenched and tempered

2) Longitudinal test piece

3) Transverse test piece

4) For wall thicknesses ≤ 8 mm apply the values: longitudinal 22 % and transverse 14 %

5) Hardness max. 85 HRB

Minimum values of the proof strength $R_{p0,2}$ at elevated temperatures

Name	0,2 %-Proof strength at the temperature °F in Ksi									
	300	400	500	600	700	800	900	1000	1100	1200
P22 ASME B31.3[a]	18,0	17,9	17,9	17,9	17,9	17,8	12,8	7,8	3,2	1,6

Name	0,2 %-Proof strength at the temperature °F in Ksi										
	-20 to 100	200	300	400	500	600	700	800	900	1000	1100
P22/T22 ASME B31.1[b]	17,1	17,1	16,6	16,6	16,6	16,6	16,6	16,6	13,6	8,0	3,8

a ASME 31.3 - Process Piping

Conversion Ksi in N/mm² (MPa): Value in Ksi x 6,895

b ASME 31.1 - Power Piping

Conversion Fahrenheit in Celsius: C = (Temp. in F - 32) x 5/9

Name	0,2 %- Proof strength at the temperature r °C in N/mm² (MPa)								
	100	150	200	250	300	350	400	450	500
10CrMo9-105	249	241	234	224	219	212	207	193	180

Reference data for some physical properties

Density at 20 °C	Modulus of elasticity kN/mm² at				Thermal conductivity at 20 °C	spec. thermal capacity at 20 °C	spec. electrical resistivity at 20 °C
kg/dm³	20 °C	300 °C	400 °C	500 °C	W/m K	J/kg K	Ω mm²/m
7,76	210	185	175	165	33	622	0,24

Linear coefficient 10^{-6} K^{-1} of thermal expansion between 20 °C and

300 °C	400 °C	500 °C	600 °C
12,9	13,5	13,9	14,1

Hot forming / Heat treatment

Hot forming		Heat treatment (quenched and tempered), microstructure		
Temperature °C	Type of cooling	Austenitization	Annealing [1]	Microstructure
1100 - 950	Air	920 - 980 °C	680 - 760 °C	bainitic/ferritic

[1] When annealing the mentioned temperatures have to be hold after achieving over the whole cross-section for minimum 30 minutes. Stress relieving anneal: 600 - 650°C. Holding time 1-2 minutes per mm plate thickness, minimum 30 minutes

Processing / Welding

Standard welding processes for these steel grades are:

- TIG-welding
- MAG-welding massive wire
- MAG- welding cored wire
- Arc welding (E)
- Submerged arc welding (SAW)

Depending on the welding position and the plate thickness, maybe other filler metals have to be applied, which can be asked inquired at the manufacturer in case of need.

For these steel grades as filler metal the following electrodes and welding wires are recommended:

Process	Filler metal
TIG	Union I CrMo 910
MAG massive wire	Union I CrMo 910
MAG cored wire	Union MV CrMo - M21
Arc welding (E)	Phoenix SH Chromium 2KS
SAW	Union S1CrMo2 / UV 420 TTR

These steels can be welded within all thickness ranges according to the afore mentioned welding processes. Preheating up to 200 °C is permitted for work pieces with thicknesses > 10 mm.

After welding for work pieces, which are subject to the technical regulations for steam boiler plants, a heat treatment has to be defined in particular. In all cases stress relieving anneal has to be performed.

When flame cutting of larger wall thicknesses is performed the cutting area has to be preheated up to 200 °C.

Remark

The material is magnetizable.

Editor

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References

ASME/ASTM A106:2010 ASTM A213:2011-02 ASTM A335:2009-03	ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken,PA 19428-2959
ASME 31.3:2010 ASME 31.1:2010	The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990
DIN EN 10216-2:2007-10	Beuth Verlag GmbH, Post box, D-10772 Berlin
Böhler Schweißtechnik Deutschland GmbH, Hamm	

Important Hint

Information given in this data sheet about property or applicability of materials respective products are no assurance of characteristics but serve for description.
Information, with which we like to advise you, relate to the experience of the producers and our own.
Warranty for the results of the treatment and application of the products cannot be granted.