

Alloyed heat-resistant Steel

Material Data Sheet

Steel designation:

Name

Material-No.

P11/T11

UNS Designation: K11597

(13CrMo4-5)

(1.7335)

Scope

This data sheet applies for seamless tubes.

Application

The material P11/T11 is particularly suitable as pipe material for superheater tubes, steam line and headers. Can be used in continuous operation to about 560 °C wall temperature.

Chemical composition (Heat analysis in %)

Name	C	Si	Mn	P	S	Al _{ges.}	Cu	Cr	Mo	Ni
P11/T11	0,05-0,15	0,50-1,00	0,30-0,60	≤ 0,025	≤ 0,025	-	-	1,00-1,50	0,44-0,65	-
13CrMo4-5	0,10-0,17	≤ 0,35	0,40-0,70	≤ 0,025	≤ 0,020	≤ 0,040	≤ 0,30	0,70-1,15	0,40-0,60	≤ 0,30

Mechanical properties at room temperature

Material	Usual ¹⁾ Delivery Condition	Wall thickness mm	Yiel strength R _{eH} /R _{p0,2} N/mm ² min.	Tensile strength R _m N/mm ²	Elongation A		Impact energy KV		
					% min.	Temperature °C	J min.		
P11/T11 ⁵⁾	+NT	-	220	415	30 ²⁾⁴⁾	20 ³⁾⁴⁾	-	-	
13CrMo4-5	+NT	≤16	290	440-590	22 ²⁾	20 ³⁾	+20	40 ²⁾	27 ³⁾
		16≤40							
		40≤60	280						

¹⁾ NT: normalized and annealed

²⁾ Longitudinal specimen

³⁾ Transverse specimen

⁴⁾ When WT ≤ 8 mm the values apply: longitudinal 22 % and transverse 14 %

⁵⁾ Hardness max. 85 HRB

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

Kurznahme	0,2 %-Yield strengt hat the temperature °F in Ksi										
	300	400	500	600	700	800	900	1000	1100	1200	
P11 ASME B31.3 ^a	18,0	17,5	17,2	16,7	15,6	15,0	12,8	6,3	2,8	1,2	
Kurznahme	0,2 %-Yield strengt hat the temperature °F in Ksi										
	-20 bis 100	200	300	400	500	600	700	800	900	1000	1100
P11/T11 ASME B31.1 ^b	17,1	17,1	17,1	16,8	16,2	15,7	15,1	14,4	13,6	6,3	2,8

^a ASME 31.3 - Process Piping

^b ASME 31.1 - Power Piping

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

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

(continued)

Name	0,2 %-Yield strengt hat the temperature °C in N/mm ² (MPa)								
	100	150	200	250	300	350	400	450	500
13CrMo4-5	264	253	245	236	192	182	174	168	166

Reference data for some physical properties

Density at 20 °C kg/dm ³	Modulus of elasticity kN/mm ² at				Thermal conductivity at 20 °C W/m K	spec. thermal capacity at 20 °C J/kg K	spec. electrical resistivity at 20 °C Ω mm ² /m
	20 °C	300 °C	400 °C	500 °C			
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	Arc welding (E)
MAG-welding massive wire	Submerged arc welding (SAW)
MAG- welding cored wire	

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.

References

ThyssenKrupp
ASTM A213:2011-02
ASTM A335:2009-03
ASME 31.3:2010
ASME 31.1:2010
DIN EN 10216-2:2007-10

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.