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Non-alloy heat resisting steel

Material data sheet

Steel designation:	Name	Material No.
	P235GH	**1.0345**

Scope

This data sheet applies for hot rolled flat products as well as for seamless and welded tubes for pressure purposes.

Application

This steel is required for construction parts in steam-generating plants, such as boilers, tubes flanges and collectors. He can be used in continuous operation up to about 450 °C and for tubes up to about 450 °C wall temperature.

Chemical composition (Heat analysis in %)

Product form	C	Si	Mn	$P_{max.}$	$S_{max.}$	Cr	Mo	Ni	Al_{total}
P	≤ 0,16	≤ 0,35	0,60[1)]-1,20	≤ 0,025	≤ 0,010	≤ 0,30	≤ 0,08	≤ 0,30	≥ 0,020
T_S	≤ 0,16	≤ 0,35	≤ 1,20	≤ 0,025	≤ 0,020	≤ 0,30	≤ 0,08	≤ 0,30	≥ 0,020[4)]
T_w	≤ 0,16	≤ 0,35	≤ 1,20	≤ 0,025	≤ 0,020	≤ 0,30	≤ 0,08	≤ 0,30	≥ 0,020[4)]
Product form	Cu	Nb	Ti	V	N				
P	≤ 0,30[3)]	≤ 0,020	≤ 0,30	≤ 0,02	≤ 0,12[2)]				
T_S	≤ 0,30[3)]	≤ 0,010[5)]	≤ 0,040[6)]	≤ 0,02[6)]	-				
T_w	≤ 0,30[3)]	≤ 0,010	≤ 0,30[6)]	≤ 0,02[6)]	-				

P = hot rolled flat products; T_S = seamless tubes

1) For Thickness < 6mm an minimum amount of manganes is acceptable, that is less than 0,20% as determined.

2) A value ratio $\frac{Al}{N}$ < 2 has to be observed.

3) a minor maximum percentage of copper and/or of stannic, e. g. Cu+6 Sn ≤ 0,33%, can be observed with relevence of the formability in the inquiry and order for steel grades, for which a maximum amount of copper is specified.

4) This requirement is not valid, if the steel contains a sufficient amount of other nitrogen binding elements, which has to be mentioned then.

Employing titanium the manufacturer has to prove that $Al + \frac{Ti}{2} \geq 0{,}020$ %.

5) Option 2: Simplifying the following formabilities, an agreed maximum amount of copper is valid which is lower than shown, and an agreed maximum amount of stannic.

6) The amounts of these elements do not have to be mentioned, if they are not added to the heat intentionally.

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Mechanical properties at room temperature

Product form	Delivery condition	Yield strength R_{eH} N/mm² for nominal thicknesses in mm		Tensile strength R_m N/mm² for nominal thicknesses in mm	Elongation min. in % $L_o = 5{,}65\sqrt{S_o}$ für Nenndicken in mm		Impact energy J min. at 0 °C for nominal thicknesses in mm	
P	N [1]	≤ 16	235	360 bis 480	≤ 16	24	≤ 16	34
		> 16 ≤ 40	225		> 16 ≤ 40		> 16 ≤ 40	
		> 40 ≤ 60	215		> 40 ≤ 60		> 40 ≤ 60	
		> 60 ≤ 100	200		> 60 ≤ 100		> 60 ≤ 100	
		> 100 ≤ 150	185	350 bis 480	> 100 ≤ 150		> 100 ≤ 150	
		> 150 ≤ 250	170	340 bis 480	> 150 ≤ 250		> 150 ≤ 250	
T_S	N [1]	≤ 16	235	360 bis 500	23		27	
		> 16 ≤ 40	225					
		> 40 ≤ 60	215					

[1] N = normalized, normalizing forming

[2] N = normalized, NW = weld area normalized

[3] L = longitudinal direction

[4] t = crosswise direction

[5] Impact values of 40J in longitudinal direction have to be proved from thickness > 16 mm

[6] Impact values of 27J in crosswise direction have to be proved optionally.

[7] Impact values in longitudinal and crosswise direction have to be proved optionally.

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Minimum values for the 0,2 %-proof strength at elevated temperatures

Product	Product thickness Mm		0,2 %-proof strength at the temperature °C									
			50	100	150	200	250	300	350	400	450	500
	over	up to (equal)	N/mm² min.									
P	0	16	227	214	198	182	167	153	142	133	-	-
	16	40	218	205	190	174	160	147	136	128	-	-
	40	60	208	196	181	167	153	140	130	122	-	-
	60	100	193	182	169	155	142	130	121	114	-	-
	100	150	179	168	156	143	131	121	112	105	-	-
	150	250	164	155	143	132	121	111	103	97	-	-
T_S/T_w		(60)[1]	-	198	187	170	150	132	120	112	(108)[2]	-

1) Tw only up to thickness 16 mm
2) Only valid for Ts.

Estimated average values for creep properties at elevated temperatures

	1 % elongation[1] for				rupture [2] for							
	10 000 h N/mm²		100 000 h N/mm²		10 000 h N/mm²		100 000 h N/mm²		200 000 h N/mm²		250 000 h N/mm²	
	P	T_S	P	T_S	P	T_S	P	T_S	P	T_S	P	T_S
380	164		118		229		165		145			
390	150		106		211		148		129			
400	136		95		191	182	132	141	115	128		122
410	124		84		174	166	118	128	101	115		109
420	113		73		158	151	103	114	89	102		97
430	101		65		142	138	91	100	78	89		86
440	91		57		127	125	79	88	67	77		74
450	80		49		113	112	69	77	57	66		64
460	72		42		100	100	59	66	48	56		54
470	62		35		86	88	50	56	40	46		44
480	53		30		75	77	42	47	33	33		30
490						67		39		26		
500						58		32		24		

1) Stress related to the out put cross-section, which leads after 10 000 or 100 000 h to a permanent elongation of 1 %.

2) Stress related to the out put cross-section, which leads after 10 000, 100 000 or 200 000 h to breakage.

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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. elecrical resistivity at 20 °C
Kg/dm³	20 °C	300 °C	400 °C	W/m K	J/kg K	Ω mm²/m
7,85	210	207	184	57,5	461	0,18

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

100 °C	200 °C	300 °C	400 °C	450 °C
12,5	13,0	13,6	14,1	14,3

Guidelines on the temperatures for hot forming and heat treatment

Hot forming		Heat treatment		
Temperature °C	Typ of cooling	Normalizing [1]	Streß revieling anneal [2]	Type of cooling
1100 - 950	Air	890 - 950 °C	600 - 650 °C	Air

[1] Normalizing: Holding time 1 minutes per mm plate thickness, minimum 30 minutes.

[2] Stress relieving anneal: Holding time 1 - 2 minutes per mm plate thickness, minimum 30 minutes.

Processing / Welding

Standard welding process for this steel grade 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 inquired at the manufacturer on demand.

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

Process	**Filler metal**	
TIG	Union I 52	
MAG massive wire	Union K 52 Union K 56	
MAG cored wire	Union MV 70 Union BA 70 (Union RV 71)	
Arc welding (E)	Phoenix 120K Phoenix Special D	
SAW	Wire	Powder
	Union S2 (Union S2)	UV 400 (UV 306)

The steels can be welded within all thickness ranges according to the afore mentioned welding processes considering the general rules of technology by hand and automatically.

The mentioned filler metals apply for highest demands. The details in brackets are for lower demands.

Burning, preheating, welding and stress relieving annealing should occur under consideration of Stahl-Eisen-material bulletin 088.

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Remark
The material is magnetizable.

References
DIN EN 10028-2:2009-09
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.