

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 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.}	Al _{total}	Cu + Cr + Mo + Ni
P	= 0,16	= 0,35	0,60 ⁴⁾ -1,20	= 0,025	= 0,010	= 0,020	= 0,70
T _S	= 0,16	= 0,35	= 1,20	= 0,025	= 0,020	= 0,020 ³⁾	= 0,70

P = hot rolled flat products; T_S = seamless tubes

Mechanical properties at room temperature (valid for transverse test pieces)

Product form	Delivery condition	Yield strength R _{eH} N/mm ² for nominal thicknesses in mm		Tensile strength R _m N/mm ² for nominal thicknesses in mm	Elongation min. in % L ₀ = 5,65 √S ₀ für Nenndicken in mm		Impact energy J min. at 0 °C for nominal thicknesses in mm	
		≤ 16	> 16		≤ 16	> 16	≤ 16	> 16
P	N ¹⁾	≤ 16	235	360 bis 480	≤ 16	24	≤ 16	34
		> 16 ≤ 40	225		> 16 ≤ 40			
		> 40 ≤ 60	215		> 40 ≤ 60			
		> 60 ≤ 100	200	> 60 ≤ 100				
		> 100 ≤ 150	185	350 bis 480	> 100 ≤ 150			
		> 150 ≤ 250	170	340 bis 480	> 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) A ratio $\frac{Al}{N} = 2$ shall apply.

3) This requirement is not applicable provided the steel contains a sufficient amount of other nitrogen binding elements which shall be reported. When using titanium, the producer shall verify that $Al + \frac{Ti}{2} = 0,020 \%$.

4) For product thicknesses < 6 mm, a minimum manganese content of 0,20 % lower than specified is permitted.

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/mm ² 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		60	-	198	187	170	150	132	120	112	108	-

Estimated average values for creep properties at elevated temperatures

	1 % elongation ¹⁾ for				rupture ²⁾ for							
	10 000 h		100 000 h		10 000 h		100 000 h		200 000 h		250 000 h	
	N/mm ²		N/mm ²		N/mm ²		N/mm ²		N/mm ²		N/mm ²	
	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.

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			
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 relieving 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
- 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 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.

Specifications and standards concerning stress relieving anneal have to be observed.

Remark

The material is magnetizable.

Editor

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References

DIN EN 10028-2:2009-09	Beuth Verlag GmbH, Postfach, D-10772 Berlin
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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.

