



# SPS

## Technical Information

STEEL SUPPLIERS TO THE WORLD'S INDUSTRIES



# Comparison of EN10225 and BS4360

BS EN 10025: 1993					BS4360: 1986								
Grade	Former Grade	Tensile Strength >3mm <100mm N/mm <sup>2</sup>	Min Yield Strength at 16mm N/mm <sup>2</sup>	Max Thk for Specified Yield N/mm <sup>2</sup>	Impact Energy (J°C)			Grade	Tensile Strength >3mm N/mm <sup>2</sup>	Min Yield Strength at 16mm N/mm <sup>2</sup>	Max Thk for Specified Yield N/mm <sup>2</sup> (2)	Impact Energy (J°C)	
					Nominal Thickness							Nominal Thickness	
					Temp °C	<150mm (1)	>150mm <250mm (1)					Temp °C	<100mm (3)
S185 (4)	Fe 310-0 (4)	290/510	185	25	-	-	-	-	-	-	-	-	-
S235 (5)	Fe 360A (5)	340/470	235	250	-	-	-	40A	340/500	235	150	-	-
S235JR (4)	Fe 360B (4)	340/470	235	25	+20	27	-	-	-	-	-	-	-
S235JRG1 (4)	Fe 360B(FU) (4)	340/470	235	25	+20 (6)	27	-	-	-	-	-	-	-
S235JRG2	Fe 360B(FN)	340/470	235	250	+20 (6)	27	23	40B	340/500	235	150	+20 (6)	27
S235JO	Fe 360C	340/470	235	250	0	27	23	40C	340/500	235	150	0	27
S235J2G3	Fe 360D1	340/470	235	250	-20	27	23	40D	340/500	235	150	-20	27
S235J2G4	Fe 360D2	340/470	235	250	-20	27	23	40D	340/500	235	150	-20	27
S275 (5)	Fe 430A (5)	410/560	275	250	-	-	-	43A	430/580	275	150	-	-
S275JR	Fe 430B	410/560	275	250	+20 (6)	27	23	43B	430/580	275	150	+20 (6)	27
S275JO	Fe 430C	410/560	275	250	0	27	23	43C	430/580	275	150	0	27
S275J2G3	Fe 430D1	410/560	275	250	-20	27	23	43D	430/580	275	150	-20	27
S275J2G4	Fe 430D2	410/560	275	250	-20	27	23	43D	430/580	275	150	-20	27
S355 (5)	Fe 510A (5)	490/630	355	250	-	-	-	50A	490/640	355	150	-	-
S355JR	Fe 510B	490/630	355	250	+20 (6)	27	23	50B	490/640	355	150	+20 (6)	27
S355JO	Fe 510C	490/630	355	250	0	27	23	50C	490/640	355	150	0	27
S355J2G3	Fe 510D1	490/630	355	250	-20	27	23	50D	490/640	355	150	-20	27
S355J2G4	Fe 510D2	490/630	355	250	-20	27	23	50D	490/640	355	150	-20	27
S355K2G3	Fe 510DD1	490/630	355	250	-20	40	33	50DD	490/640	355	150	-30	27
S355K2G4	Fe 510DD2	490/630	355	250	-20	40	33	50DD	490/640	355	150	-30	27
E295	Fe490-2	470/610	295	250	-	-	-	-	-	-	-	-	-
E335	Fe 590-2	570/710	335	250	-	-	-	-	-	-	-	-	-
E360	Fe 690-2	670/830	360	250	-	-	-	-	-	-	-	-	-

Comparison Between Grades in BS EN 10 025: 1993 and BS 4360: 1986

- (1) For sections up to and including 100mm only
- (2) For wide flats and Sections up to and including 63mm and 100mm respectively
- (3) For wide flats up to and including 50mm and for sections no limit is stated
- (4) Only available up to and including 25mm thick
- (5) The Steel grades S235 (Fe 360A), S275 (Fe 430A), and S355 (Fe 510A) appear only in the English language version (BS EN 10025) as non conflicting additions and do not appear in European versions
- (6) Verification of the specified impact value is only carried out when agreed at time of enquiry and order

# UK and International Equivalent Grades

Designation		Equivalent Former Designations in													
EN 10025: 1993 Designation		According EN 10025: 1990	Germany DIn 17100	France NFA 35-501	UK BS4360	Spain	Italy	Belgium	Sweden	Portugal	Austria	Norway NS12101	USA ASTM	USA API	Japan JIS G3101/8
Steel Name	Steel Number														
S185	1.0035	Fe 310-0	St 33	A33		A3 10-0	Fe 320	A320	13 00-00	Fe 310-00	St 320				
S235JR	1.0037	Fe 360B	St 37-2	E24-2			Fe 360B	AE 235-B	13 11-00	Fe 360-B		NS 12 120	A283 GrC		
S235JRG1	1.0036	Fe 360BFU	U St 37-2				AE 235 B-FU				U St 360 B	NS 12 122	A283 GrD		SM41A
S235JRG2	1.0038	Fe 360BFN	R St 37-2		40B		AE 235 B-FN		13 12-00		R St 360 B	NS 12 123			SM41B
S235JO	1.0114	Fe 360C	St 37-3U	E 24-3	40C		AE 235 D	Fe 360C		Fe 360-C	St 360 C	NS 12 142			
S235J2G3	1.0116	Fe 360 D1	St 37-3N	E 24-4	40D		Fe 360D	AE 236-D		Fe 360-D	St 360D	NS 12 124			
S235J2G4	1.0117	Fe 360 D2													
S275JR	1.0044	Fe 430B	ST 44-2	E 28-2	43B	AE 275 B	Fe 430 B	AE 255-B	14 12-00	Fe 430 B	ST 430 B	NS 12-142	A673 Gr55		SS490
S275JO	1.0143	Fe 430C	ST 44-3U	E 28-3	43C	AE 275 C	Fe 430 C	AE 255-C		Fe 430 C	ST 430 C	NS 12-143			
S275J2G3	1.0144	Fe 430D1	ST 430 D1	E 28-4	43D	AE 275 D	Fe 430 D	AE 255-D	14 14-00	Fe 430 D	ST 430 CE	NS 12-143	A633 GrA	2H Gr42	
S275J2G4	1.0145	Fe430D2							14 14-01						
S355JR	1.0045	Fe 510 B		E 36-2	50B	AE 355B	Fe 510B	AE 355B		Fe 510-B	St 510C	NS 12 153	A672Gr50		SS490
S355JO	1.0553	Fe 510 C	ST 52-3U	E 36-3	50C	AE 355C	Fe 510C	AE 355C		Fe 510-C	St 510D	NS 12 153	A709Gr50	2H Gr 50	
S355J2G3	1.0570	Fe 510 D1	ST 62-3N		50D	AE 355D	Fe 510D	AE 355D		Fe 510-D	St 510D	NS 12 153	A678 Gr50	2W/YGr50	
S355J2G4	1.0577	Fe 510 D2													
S355K2G3	1.0595	Fe 510 DD1		E36-4	50DD			AE355DD		Fe 510DD			A633GrD		
S355K2G4	1.0596	Fe 510 DD2			50DD										
E 295	1.0050	Fe 490-2	ST 50-2	A 50-2		A 490	Fe 480	A 490-2	15 50-00 15 50-01	Fe 490-2	St490				
E355	Fe 590-2	St 590-2	St 60-2	A 60-2		A590	Fe 580	A590-2	16 50-00 16 50-01	Fe 590-2	St 590				
E 360	1.0070	Fe 690-2	St 70-2	A 70-2		A690	Fe 650	A690-2	18 55-00 16 55-01	Fe 690-2	St 690				



# Chemical and Mechanical Properties of EN10225

#### Table 4 — Chemical composition for plates

Group	Steel name	Steel number	C	Si	Mn	P	S	Cr	Mo	Ni	Al (Total) <sup>b</sup>	Cu	N	Nb	Ti	V	Cr+Mo+Ni+Cu	Nb+V	Nb+V+Ti
			max.			max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.
			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ladle analysis <sup>a</sup>																			
1	S355G2+N	1.8801+N	0,20	0,50 max.	0,90 to 1,65	0,035	0,030	0,30	0,10	0,50	0,020 min.	0,35	0,015	0,060	0,030	0,12	-	-	-
1	S355G3+N	1.8802+N	0,18	0,50 max.	0,90 to 1,65	0,030	0,025	0,30	0,10	0,50	0,020 min.	0,35	0,015	0,060	0,030	0,12	-	-	-
1	S355G5+M	1.8804+M	0,14	0,50 max.	1,60 max.	0,035	0,030	-	0,20	0,30	0,020 min.	-	0,015	0,050	0,050	0,10	-	-	-
1	S355G6+M	1.8805+M	0,14	0,50 max.	1,60 max.	0,030	0,025	-	0,20	0,30	0,020 min.	-	0,015	0,050	0,050	0,10	-	-	-
Ladle and product analysis																			
2	S355G7+M <sup>c</sup> S355G7+N <sup>c</sup>	1.8808+M 1.8808+N	0,14	0,15 to 0,55	1,00 to 1,65	0,020	0,010	0,25	0,08	0,50	0,015/0,055	0,30	0,010	0,040	0,025	0,060	0,90	0,06	0,08
3	S355G8+M <sup>c</sup> S355G8+N <sup>c</sup>	1.8810+M 1.8810+N	0,14	0,15 to 0,55	1,00 to 1,65	0,020	0,007	0,25	0,08	0,50	0,015/0,055	0,30	0,010	0,040	0,025	0,060	0,90	0,06	0,08
2	S355G9+N <sup>c</sup> S355G9+M <sup>c</sup>	1.8811+N 1.8811+M	0,12	0,15 to 0,55	1,65 max.	0,020	0,010	0,20	0,08 <sup>d</sup>	0,70 <sup>e</sup>	0,015/0,055	0,30	0,010	0,030	0,025	0,060	-	0,06	0,08
3	S355G10+N <sup>c</sup> S355G10+M <sup>c</sup>	1.8813+N 1.8813+M	0,12	0,15 to 0,55	1,65 max.	0,015	0,005	0,20	0,08 <sup>d</sup>	0,70 <sup>e</sup>	0,015/0,055	0,30	0,010	0,030	0,025	0,060	-	0,06	0,08
2	S420G1+Q <sup>c</sup> S420G1+M <sup>c</sup>	1.8830+Q 1.8830+M	0,14 <sup>f</sup>	0,15 to 0,55	1,65 max.	0,020	0,010	0,25	0,25	0,70	0,015/0,055	0,30	0,010	0,040	0,025	0,080	0,90	0,09	0,11
3	S420G2+Q <sup>c</sup> S420G2+M <sup>c</sup>	1.8857+Q 1.8857+M	0,14 <sup>f</sup>	0,15 to 0,55	1,65 max.	0,020	0,007	0,25	0,25	0,70	0,015/0,055	0,30	0,010	0,040	0,025	0,080	0,90	0,09	0,11
2	S460G1+Q <sup>c</sup> S460G1+M <sup>c</sup>	1.8878+Q 1.8878+M	0,14 <sup>f</sup>	0,15 to 0,55	1,65 max.	0,020	0,010	0,25	0,25	0,70	0,015/0,055	0,30	0,010	0,040	0,025	0,080	0,90	0,09	0,11
3	S460G2+Q <sup>c</sup> S460G2+M <sup>c</sup>	1.8887+Q 1.8887+M	0,14 <sup>f</sup>	0,15 to 0,55	1,65 max.	0,020	0,007	0,25	0,25	0,70	0,015/0,055	0,30	0,010	0,040	0,025	0,080	0,90	0,09	0,11

NOTE For details on delivery conditions refer back to 7.3.1.

<sup>a</sup> For product chemical composition variations see Table 12.

<sup>b</sup> The total aluminium to nitrogen ratio shall be a minimum of 2:1. When other nitrogen binding elements are used, the minimum Al value and Al:N ratio does not apply.

<sup>c</sup> The levels of the residual elements arsenic, antimony, tin, lead, bismuth and calcium shall not exceed 0,03 % As, 0,010 % Sb, 0,020 % Sn, 0,010 % Pb, 0,010 % Bi and 0,005 % Ca. Boron (B) shall not exceed 0,000 5 %. These elements shall be checked at least once every 5 000 tonnes at each manufacturing location and shall be reported as a ladle analysis.

<sup>d</sup> For thicknesses greater than 75 mm, maximum Mo content of 0,20 % shall apply for delivery condition M.

<sup>e</sup> See option 30. For thicknesses greater than 40 mm, the minimum Ni content shall be 0,30 %.

<sup>f</sup> A maximum carbon value of 0,15 % is permitted for thicknesses less than 15 mm.

#### Table 5a — Mechanical properties for plates — S355 grades see also Table 5d

Group	Steel name	Steel number	Tensile strength R <sub>m</sub> <sup>a</sup>		Minimum yield strength R <sub>eH</sub> for thickness t (mm)							Minimum elongation A on gauge length of 5,65 √S <sub>0</sub> <sup>b</sup>	Minimum average Charpy V-notch impact test value	Thickness maximum
			Thickness t (mm) ≤ 100	Thickness t (mm) > 100	t ≤ 16	16 < t ≤ 25	25 < t ≤ 40	40 < t ≤ 63	63 < t ≤ 100	100 < t ≤ 150				
1	S355G2-N	1.8801+N	470 to 630	470 to 630	355	345	345	-	-	-	-	22	20	20
1	S355G3-N	1.8802+N	470 to 630	470 to 630	355	345	345	-	-	-	-	22	20	20
1	S355G5+M	1.8804+M	470 to 630	470 to 630	355	345	345	-	-	-	-	22	20	20
1	S355G6+M	1.8805+M	470 to 630	470 to 630	355	345	345	-	-	-	-	22	20	20
2	S355G7+N	1.8808+N	470 to 630	470 to 630	355	345	345	335	325	320	22	20	20	
3	S355G8+N	1.8810+N	470 to 630	470 to 630	355	345	345	325	325	320	22	20	20	
2	S355G9+M	1.8811+M	470 to 630	470 to 630	355	345	345	325	325	320	22	20	20	
3	S355G10+M	1.8811+M	470 to 630	470 to 630	355	345	345	325	325	320	22	20	20	
2	S420G1+N	1.8811+N	470 to 630	470 to 630	355	345	345	335	325	320	22	20	20	
3	S420G2+N	1.8857+N	470 to 630	470 to 630	355	345	345	335	325	320	22	20	20	
3	S460G1+M	1.8878+M	470 to 630	470 to 630	355	345	345	335	325	320	22	20	20	
3	S460G2+M	1.8887+M	470 to 630	470 to 630	355	345	345	335	325	320	22	20	20	

NOTE The specified tensile strength and elongation values apply to the maximum thickness for which minimum yield strengths are specified.

<sup>a</sup> Charpy V-notch and thickness tests are also required for thicknesses over 40 mm.

<sup>b</sup> In the case of girth welding the mechanical properties shall be carried out 90-100 °C in lieu of 40 °C.

<sup>c</sup> 1 MPa = 1 N/mm<sup>2</sup>.

#### Table 5b — Mechanical properties for plates — S460 grades (see also Table 5d)

Thickness range (mm)	Minimum yield strength R <sub>eH</sub> (MPa)						Tensile strength R <sub>m</sub> (MPa)	Minimum elongation A on gauge length (A <sub>5.65</sub> ) (%)
	≤ 16	> 16 ≤ 25	> 25 ≤ 40	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100		
540 to 730	480	470	470	415	405	600	17	
730 to 920	530 to 600	520 to 600	515 to 625	505 to 665	500 to 690	600	17	
920 to 1100	570 to 660	560 to 660	555 to 665	545 to 665	540 to 660	600	17	

<sup>a</sup> Charpy V-notch and thickness tests are also required for thicknesses over 40 mm.

<sup>b</sup> 1 MPa = 1 N/mm<sup>2</sup>.

#### Table 5d — Yield to tensile strength ratios for plates excluding steels of group 1

Grade	Yield to tensile strength ratio	
All S355+N grades	max. 0,87	
All S355+M grades	> 16 mm	0,85
	< 16 mm	0,93 <sup>a</sup>
All S420 grades	> 16 mm	0,90
	< 16 mm	0,93
All S460 grades	> 16 mm	0,88
	< 16 mm	0,93
> 16 mm	0,90	

<sup>a</sup> For plates > 12 mm, alternative yield to tensile strength ratios may be agreed.



# SPS

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STEEL SUPPLIERS TO THE WORLD'S INDUSTRIES



# Chemical and Mechanical Properties of EN10225

**Table 6 — Chemical composition for sections**

Group	Steel name	Steel number	C	Si	Mn	P	S	Cr	Mo	Ni	Al (Total) <sup>b</sup>	Cu	N	Nb	Ti	V	Cr+Mo+N+Cu	Nb+V	Nb+V+Ti
			max.	max.	%	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.
Ladle analysis <sup>d</sup>																			
1	S355G1 <sup>e</sup> S355G1+N	1.8814 1.8814+N	0,20	0,50	0,90 to 1,65	0,035	0,030	0,30	0,10	0,50	0,020 min.	0,35	0,015	0,050	0,030	0,120	-	-	-
1	S355G4 <sup>e</sup> S355G4+M	1.8803 1.8803+M	0,16	0,50	1,60 max.	0,035	0,030	-	0,20	0,30	0,020 min.	0,35	0,015	0,050	0,050	0,100	-	-	-
Ladle and product analysis																			
2	S355G11 <sup>c,d</sup> S355G11+N <sup>e</sup> S355G11+M <sup>c</sup>	1.8806 1.8806+N 1.8806+M	0,14	0,55	1,65 max.	0,025	0,015	0,25	0,08	0,50	0,015/ 0,055	0,30	0,012	0,040	0,025	0,060	0,80	0,06	0,08
3	S355G12 <sup>c,d</sup> S355G12+N <sup>e</sup> S355G12+M <sup>c</sup>	1.8809 1.8809+N 1.8809+M	0,14	0,55	1,65 max.	0,020	0,007	0,25	0,08	0,50	0,015/ 0,055	0,30	0,012	0,040	0,025	0,060	0,80	0,06	0,08
2	S420G3 <sup>c,d</sup> S420G3+M <sup>c</sup>	1.8851 1.8851+M	0,14	0,55	1,65 max.	0,025	0,015	0,25	0,08	0,70	0,015/ 0,055	0,30	0,012	0,050	0,025	0,080	0,80	0,09	0,11
3	S420G4 <sup>c,d</sup> S420G4+M <sup>e</sup>	1.8859 1.8859+M	0,14	0,55	1,65 max.	0,020	0,007	0,25	0,08	0,70	0,015/ 0,055	0,30	0,012	0,050	0,025	0,080	0,80	0,09	0,11
2	S460G3 <sup>c,d</sup> S460G3+M <sup>e</sup>	1.8883 1.8883+M	0,14	0,55	1,70 max.	0,025	0,015	0,25	0,08	0,70	0,015/ 0,055	0,30	0,012	0,050	0,025	0,080	0,80	0,12	0,13
3	S460G4 <sup>c,d</sup> S460G4+M <sup>c</sup>	1.8889 1.8889+M	0,14	0,55	1,70 max.	0,020	0,007	0,25	0,08	0,70	0,015/ 0,055	0,30	0,012	0,050	0,025	0,080	0,80	0,12	0,13

NOTE <sup>a</sup> For product chemical composition variations see Table 12.

<sup>b</sup> The total aluminium to nitrogen ratio shall be a minimum of 2:1. When other nitrogen binding elements are used, the minimum Al value and Al:N ratio does not apply.

<sup>c</sup> The levels of the residual elements arsenic, antimony, tin, lead, bismuth and calcium shall not exceed 0,03 % As, 0,010 % Sb, 0,020 % Sn, 0,010 % Pb, 0,010 % Bi and 0,005 % Ca. Boron (B) shall not exceed 0,000 5 %. These elements shall be checked at least once every 5 000 tonnes at each manufacturing location and shall be reported as a ladle analysis.

<sup>d</sup> As-rolled condition limited to a maximum thickness of 25 mm.

**Table 7 — Mechanical properties for sections**

Group	Steel name	Steel number	Tensile strength R <sub>m</sub>	Minimum yield strength R <sub>m</sub> for thickness t (mm)				Minimum on elongation A gauge length of 5,65√S <sub>0</sub>	Minimum average Charpy V-notch impact test value		
									R <sub>d</sub> /R <sub>m</sub> maximum ratio	Temp	Energy
				t ≤ 16	16 < t ≤ 40	40 < t ≤ 63	R <sub>d</sub> /R <sub>m</sub> maximum ratio			°C	J
1	S355G1 <sup>a</sup> S355G1+N	1.8814 1.8814+N	470 to 630	355	345 <sup>d</sup>	-	0,87	22	-20	50	
1	S355G4 <sup>a</sup> S355G4+M	1.8803 1.8803+M	450 to 610	355	345 <sup>d</sup>	-	0,87	22	-20	50	
2	S355G11 <sup>a</sup> S355G11+N S355G11+M	1.8806 1.8806+N 1.8806+M	460 to 620	355	345	335	0,87	22	-40 <sup>b</sup>	50 <sup>a</sup>	
3	S355G12 <sup>a</sup> S355G12+N S355G12+M	1.8809 1.8809+N 1.8809+M	460 to 620	355	345	335	0,87	22	-40 <sup>b</sup>	50 <sup>a</sup>	
2	S420G3 <sup>a</sup> S420G3+M	1.8851 1.8851+M	500 to 690	420	410	400	0,90	19	-40 <sup>b</sup>	60	
3	S420G4 <sup>a</sup> S420G4+M	1.8859 1.8859+M	500 to 690	420	410	400	0,90	19	-40 <sup>b</sup>	60 <sup>c</sup>	
2	S460G3 <sup>a</sup> S460G3+M	1.8883 1.8883+M	530 to 720	460	440	430	0,90	17	-40 <sup>b</sup>	60	
3	S460G4 <sup>a</sup> S460G4+M	1.8889 1.8889+M	530 to 720	460	440	430	0,90	17	-40 <sup>b</sup>	60 <sup>c</sup>	

When agreed at the time of enquiry and order, sections with thicknesses greater than specified shall be supplied, see option 25.

<sup>a</sup> See option 26.

<sup>b</sup> For up to and including 25 mm thickness, test at -20 °C.

<sup>c</sup> See option 27.

<sup>d</sup> Available up to 25 mm thick only.

<sup>e</sup> As rolled condition limited to maximum thickness of 25 mm.

<sup>f</sup> 1 MPa = 1 N/mm<sup>2</sup>.



**Table 10 — Chemical composition for seamless hollow sections**

Group	Steel name	Steel number	C max.	Si	Mn	P max.	S max.	Cr max.	Mo max.	Ni max.	Al(Total) <sup>b</sup>	Cu max.	N max.	Nb max.	Ti max.	V max.	Cr+Mo+Ni+Cu max.	Nb+V max.	Nb+V+Ti max.
			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ladle analysis <sup>a</sup>																			
1	S355G1N	1.8814+N	0,20	0,50 max.	0,90 to 1,65	0,035	0,030	0,30	0,10	0,50	0,020 min.	0,35	0,015	0,050	0,030	0,120	-	-	-
Ladle and product analysis																			
2	S355G14+Q <sup>c</sup> S355G14+N <sup>c</sup>	1.1184+Q 1.1184+N	0,18	0,15 to 0,55	1,60 max.	0,025	0,010	0,25	0,08	0,30	0,06 max.	0,35	0,014	0,050	0,02	0,10	0,80	0,10	0,12
3	S355G15+N <sup>c</sup> S355G15+Q <sup>c</sup>	1.1190+N 1.1190+Q	0,18	0,15 to 0,55	1,60 max.	0,025	0,007	0,25	0,08	0,30	0,06 max.	0,35	0,014	0,050	0,02	0,10	0,80	0,10	0,12
2	S420G6+Q <sup>c</sup>	1.8852+Q	0,16	0,15 to 0,55	1,00 to 1,65	0,025	0,007	0,30	0,25	0,65	0,06 max.	0,30	0,014	0,050	0,04	0,10	0,80	0,10	0,12
2	S460G6+Q <sup>c</sup>	1.8884+Q	0,16	0,15 to 0,55	1,00 to 1,65	0,025	0,010	0,30	0,25	0,65	0,06 max.	0,30	0,014	0,050	0,04	0,10	0,80	0,10	0,12

<sup>a</sup> For product chemical composition variations see Table 12.

<sup>b</sup> The total aluminium to nitrogen ratio shall be a minimum of 2:1. When other nitrogen binding elements are used, the minimum Al value and Al:N ratio does not apply.

<sup>c</sup> The levels of the residual elements arsenic, antimony, tin, lead, bismuth and calcium shall not exceed 0,02 % As, 0,010 % Sb, 0,020 % Sn, 0,010 % Pb, 0,010 % Bi and 0,005 % Ca. Boron (B) shall not exceed 0,000 5 %. These elements shall be checked at least once every 5 000 tonnes at each manufacturing location and shall be reported as a ladle analysis.

**Table 11 — Mechanical properties for seamless hollow sections**

Group	Steel name	Steel number	Tensile strength $R_m$	Minimum yield strength $R_{eH}$ for thickness $t$ (mm) <sup>a</sup>			Minimum elongation $A$ on gauge length of $5,65 \sqrt{S_0}$	Minimum average Charpy V-notch impact test value	
				$t \leq 20$	$20 < t \leq 40$	$R_{eH}/R_m$		Temp.	Energy
				MPa <sup>b</sup>	MPa <sup>b</sup>	MPa <sup>b</sup>		max. ratio	°C
1	S355G1+N	1.8814+N	470 to 630	355	345	0,88	22	-20	50
2	S355G14+N S355G14+Q	1.1184+N 1.1184+Q	460 to 620	355	345	0,88	22	-40	50
3	S355G15+N S355G15+Q	1.1190+N 1.8852+Q	460 to 620	355	345	0,88	22	-40	50
2	S420G6+Q	1.8852+Q	500 to 690	420	400	0,90	22	-40	60
2	S460G6+Q	1.8884+Q	550 to 700	460	440	0,90	19	-40	60

<sup>a</sup> When agreed at the time of enquiry and order, hollow sections with thicknesses greater than specified shall be supplied, see option 25.

<sup>b</sup> 1 MPa = 1 N/mm<sup>2</sup>.



# SPS

## Technical Information

STEEL SUPPLIERS TO THE WORLD'S INDUSTRIES



# Boiler/Pressure Vessel Comparisons and Equivalents

### BOILER & PRESSURE VESSEL - COMPARISONS AND EQUIVALENTS

EQUIVALENT SPECIFICATIONS & STANDARDS				MECHANICAL VALUES		CHEMICAL COMPOSITION MAXIMUM ( unless stated)												
B5	EN	ASTM / ASME	DIN	Tensile N / mm <sup>2</sup>	Yield / min N / mm <sup>2</sup>	C	Si	Mn	P	S	Al	Cr	Cu	Ni	Mo	Nb	Ti	V
161-360A/B	P235GH	A 285 GR C	H 1	360 / 480	235	0.16	0.35	0.40/1.20	0.030	0.025	0.020	0.30	0.30	0.30	0.08	0.01	0.03	0.02
161-430A/B	P265GH	A 516 - 60	H 11	410 / 530	265	0.20	0.40	0.50/1.40	0.030	0.025	0.020	0.30	0.30	0.30	0.08	0.01	0.03	0.02
224-400A/B	P275N/NH			390 / 510	275	0.18	0.40	0.50/1.40	0.030	0.025	0.020	0.30	0.30	0.50	0.08	0.05	0.03	0.05
224-460A/B	P295GH	A 516 - 65	17 MN 4	460 / 580	295	0.08/0.20	0.40	0.90/1.50	0.030	0.025	0.020	0.30	0.30	0.30	0.08	0.01	0.03	0.02
224-490A/B	P355GH	A 516 - 70		510 / 650	355	0.10/0.22	0.60	1.00/1.70	0.030	0.025	0.020	0.30	0.30	0.30	0.08	0.01	0.03	0.02
225-490A/B	P355N/NH		19 MN 6	490 / 630	355	0.20	0.50	0.90/1.70	0.030	0.025	0.020	0.30	0.30	0.50	0.08	0.05	0.03	0.10
243	16 MO3	A 204 GR A	15 MO 3	440 / 590	275	0.12/0.20	0.35	0.40/0.90	0.030	0.025		0.30	0.30	0.30	0.25/0.35			
620 B	13CRMO45	A 387-12-2	13CRMO44	450 / 600	300	0.08/0.18	0.35	0.40/1.00	0.030	0.025		0.70/1.15	0.30		0.40/0.60			
621 B		A 387-11-2		515 / 690	340	0.09/0.17	0.50/0.80	0.40/0.65	0.025	0.015	0.020	1.00/1.50	0.30	0.30	0.45/0.60			
622-515B	1D/11CRMO910	A387-22-2	10CRMO910	520 / 630	310	0.08/0.14	0.50	0.40/0.80	0.030	0.025		2.00/2.50	0.30		0.90/1.10			

# Diameter/Nominal Wall Thickness Schedule Pipes

Nominal Pipe Inch	Outside Diameter mm	Diameter & Nominal Wall Thickness Schedule - Pipes																Nominal Pipe Inch	
		5S	10S	10	20	30	40S	STD Wgt	40	60	80S	XS	80	100	120	140	160		XXS
1/2	21.34	1.65	2.11				2.77	2.77	2.77		3.73	3.73	3.73				4.77	7.47	1/2
3/4	26.67	1.65	2.11				2.87	2.87	2.87		3.91	3.91	3.91				5.56	7.85	3/4
1	33.40	1.65	2.77				3.38	3.38	3.38		4.55	4.55	4.55				6.35	9.09	1
1 1/4	42.16	1.65	2.77				3.56	3.56	3.56		4.85	4.85	4.85				6.35	9.7	1 1/4
1 1/2	48.26	1.65	2.77				3.68	3.68	3.68		5.08	5.08	5.08				7.14	10.16	1 1/2
2	60.32	1.65	2.77				3.91	3.91	3.91		5.54	5.54	5.54				8.74	11.07	2
2 1/2	73.02	2.11	3.05				5.16	5.16	5.16		7.01	7.01	7.01				9.52	14.02	2 1/2
3	88.90	2.11	3.05				5.49	5.49	5.49		7.62	7.62	7.62				11.12	15.24	3
3 1/2	101.60	2.11	3.05				5.74	5.74	5.74		8.08	8.08	8.08						3 1/2
4	114.30	2.11	3.05				6.02	6.02	6.02		8.56	8.56	8.56		11.12		13.49	17.12	4
5	141.30	2.77	3.40				6.55	6.55	6.55		9.52	9.52	9.52		12.70		15.87	19.05	5
6	168.27	2.77	3.40				7.11	7.11	7.11		10.97	10.97	10.97		14.27		18.26	21.95	6
8	219.07	2.77	3.76		6.35	7.04	8.18	8.18	8.18	10.31	12.70	12.70	12.70	15.08	18.26	20.63	23.01	22.22	8
10	273.05	3.40	4.19		6.35	7.80	9.27	9.27	9.27	12.70	12.70	12.70	15.08	18.26	21.44	25.40	28.57	25.40	10
12	323.85	3.96	4.57		6.35	8.38	9.52	9.52	10.31	14.27	12.70	12.70	17.47	21.44	25.40	28.57	33.32	25.40	12
14	355.60	3.96	4.77	6.35	7.92	9.52		9.52	11.12	15.09		12.70	19.05	23.82	27.79	31.75	35.71		14
16	405.40	4.19	4.77	6.35	7.92	9.52		9.52	12.70	16.66		12.70	21.44	26.19	30.96	36.53	40.49		16
18	457.20	4.19	4.77	6.35	7.92	11.12		9.52	14.27	19.05		12.70	23.82	29.36	34.92	39.67	45.24		18
20	508.00	4.77	5.54	6.35	9.52	12.70		9.52	15.08	20.62		12.70	26.19	32.54	38.10	44.45	50.01		20
22	558.80	4.77	5.54	6.35	9.52	12.70		9.52	15.87	22.22		12.70	28.57	34.92	41.27	47.62	53.97		22
24	609.60	5.54	6.35	6.35	9.52	14.27		9.52	17.47	24.61		12.70	30.96	28.89	46.02	52.37	59.54		24
26	660.40			7.92	12.70			9.52				12.70							26
28	711.20			7.92	12.70	15.87		9.52				12.70							28
30	762.00	6.35		7.92	12.70	15.87		9.52				12.70							30
32	812.80			7.92	12.70	15.87		9.52	17.47			12.70							32
34	863.60			7.92	12.70	15.87		9.52	17.47			12.70							34
36	914.40			7.92	12.70	15.87		9.52	19.05			12.70							36



# Stainless Steel - Chemical Composition

Steel designations for ordering	Chemical composition, average %										National steel designations superseded by EN			
	C	N	Cr	Ni	Mo	Others	BS	DIN	NF	SS				
1.4016	0.04	-	16.5	-	-	-	430S17	1.4016	Z8 C17	2320				
1.4510	0.04	-	18	-	-	Ti	-	1.4510	Z4 CT17	-				
1.4521	0.02	0.02	17.8	-	2.1	Ti	-	1.4521	Z3 CDT 18-02	2326				
1.4021	0.20	-	13	-	-	-	420S29	1.4021	Z20 C13	2303				
1.4028	0.30	-	12.5	-	-	-	420S45	1.4028	Z33 C13	2304				
1.4418	0.03	0.04	16	5	1	-	-	1.4418	Z6 CND 16-05-01	2387				
1.4362	0.02	0.10	23	4.8	0.3	-	-	1.4362	Z3 CN 23-04 Az	2327				
1.4460	0.02	0.09	25.2	5.6	1.4	-	-	1.4460	Z5 CND 27-05 Az	2324				
1.4462	0.02	0.17	22	5.7	3.1	-	318S13	1.4462	Z3 CND 22-05 Az	2377				
1.4410	0.02	0.27	25	7	4	-	-	-	Z3 CND 25-06 Az	2328				
1.4310	0.10	0.03	17	7	-	-	301S21	1.4310	Z11 CN 18-08	2331				
1.4318	0.02	0.15	17	7	-	-	-	-	Z3 CN 18-07 Az	-				
1.4372	0.05	0.15	17	5	-	6.5Mn	-	-	Z12 CMN 17-07 Az	-				
1.4307	0.02	0.06	18.1	8.3	-	-	304S11	-	Z3 CN 18-10	2352				
1.4301	0.04	0.05	18.1	8.3	-	-	304S31	1.4301	Z7 CN 18-09	2333				
1.4311	0.02	0.14	18.2	8.7	-	-	304S61	1.4311	Z3 CN 18-10 Az	2371				
1.4541	0.04	0.01	17.3	9.1	-	Ti	321S31	1.4541	Z6 CNT 18-10	2337				
1.4305	0.05	0.06	17.3	8.2	-	S	303S31	1.4305	Z8 CNF 18-09	2346				
1.4306	0.02	0.04	18.2	10.1	-	-	304S11	1.4306	Z3 CN 18-10	2352				
1.4303	0.02	0.02	17.7	11.2	-	-	305S19	1.4303	Z1 CN 18-12	-				
1.4567	0.01	0.02	17.7	9.7	-	3.3Cu	-	1.4567	Z3 CNU 18-09 FF	-				
1.4404	0.02	0.04	17.2	10.2	2.1	-	316S11	1.4404	Z3 CND 17-11-02	2348				
1.4401	0.02	0.04	17.2	10.2	2.1	-	316S31	1.4401	Z7 CND 17-11-02	2347				
1.4406	0.02	0.14	17.2	10.3	2.1	-	316S61	1.4406	Z3 CND 17-11 Az	-				
1.4571	0.04	0.01	16.8	10.9	2.1	Ti	320S31	1.4571	Z6 CNDT 17-12	2350				
1.4432	0.02	0.05	16.9	10.7	2.6	-	316S13	-	Z3 CND 17-12-03	2353				
1.4436	0.02	0.05	16.9	10.7	2.6	-	316S33	1.4436	Z7 CND 18-12-03	2343				
1.4435	0.02	0.06	17.3	12.6	2.6	-	316S13	1.4435	Z3 CND 18-14-03	2353				
1.4429	0.02	0.14	17.3	12.5	2.6	-	316S63	1.4429	Z3 CND 17-12 Az	2375				
1.4438	0.02	0.07	18.2	13.7	3.1	-	317S12	1.4438	Z3 CND 19-15-04	2367				
1.4439	0.02	0.14	17.8	12.7	4.1	-	-	1.4439	Z3 CND 18-14-05 Az	-				
1.4539	0.01	0.06	20	25	4.3	1.5Cu	904S13	1.4539	Z2 NCDU 25-20	2562				
1.4547	0.01	0.20	20	18	6.1	Cu	-	-	-	2378				
1.4652	0.01	0.50	24	22	7.3	3.5Mn, Cu	-	-	-	-				
1.4948	0.05	0.06	18.1	8.3	-	-	304S51	1.4948	Z6 CN 18-09	2333				
1.4878	0.05	0.01	17.3	9.1	-	Ti	321S51	1.4878	Z6 CNT 18-10	2337				
1.4818	0.05	0.15	18.5	9.5	-	1.3Si, Ce	-	-	-	2372				
1.4833	0.06	0.08	22.3	12.6	-	-	309S16	1.4833	Z15 CN 24-13	-				
1.4828	0.04	0.04	20	12	-	Z5i	-	1.4828	Z17 CN5 20-12	-				
1.4835	0.09	0.17	21	11	-	1.6Si, Ce	-	-	-	2368				
1.4845	0.05	0.04	25	20	-	-	310S16	1.4845	Z8 CN 25-20	2361				
1.4854	0.05	0.17	25	35	-	1.3Si, Ce	-	-	-	-				

WET CORROSION AND GENERAL SERVICE

HEAT AND CREEP