

ELEMENT (MAX)	ST37-2 ( EN10025-2 )			ST52-3 ( EN10025-2 )			X70-PSL2 (API-5L)
	T≤16	16<T≤40	T>40	T≤16	16<T≤40	T>40	T=20
C	0.17	0.17	0.20	0.20	0.20	0.22	0.15
Mn	1.40			1.60			1.50
Si	-			0.55			0.35
S	0.035			0.030			0.010
P	0.035			0.030			0.020
N	0.012			0.012			-
Cu	0.55			0.55			0.15
Nb	-			-			0.04
Ni	-			-			0.20
V	-			-			0.08
Nb+V+Ti	-			-			0.12
Cr+Mo+Ni	-			-			0.60
Ti	-			-			0.04
Cr	-			-			0.20
Mo	-			-			0.10
B	-			-			0.0005
Ca	-			-			0.006
CE	T≤30	30<T≤40	40<T≤150	T≤30	30<T≤40	40<T≤150	0.39
	0.35	0.35	0.38	0.45	0.47	0.47	
PCM	-			-			0.21

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Elements	Composition, %					
	Grade A	Grade B	Grade E	Grade F	Grade J	Grade P
Carbon:						
Heat analysis	0.15–0.21	0.15–0.21	0.12–0.20	0.10–0.20	0.12–0.21	0.12–0.21
Product Analysis	0.13–0.23	0.13–0.23	0.10–0.22	0.08–0.22	0.10–0.23	0.10–0.23
Manganese:						
Heat analysis	0.80–1.10	0.70–1.00	0.40–0.70	0.60–1.00	0.45–0.70	0.45–0.70
Product analysis	0.74–1.20	0.64–1.10	0.35–0.78	0.55–1.10	0.40–0.78	0.40–0.78
Phosphorus, max <sup>A</sup>	0.035	0.035	0.035	0.035	0.035	0.035
Sulfur, max <sup>A</sup>	0.035	0.035	0.035	0.035	0.035	0.035
Silicon:						
Heat analysis	0.40–0.80	0.15–0.35	0.10–0.40	0.15–0.35	0.20–0.35	0.20–0.35
Product analysis	0.34–0.86	0.13–0.37	0.08–0.45	0.13–0.37	0.18–0.37	0.18–0.37
Nickel:						
Heat analysis	...	...	...	0.70–1.00	...	1.20–1.50
Product analysis	...	...	...	0.67–1.03	...	1.15–1.55
Chromium:						
Heat analysis	0.50–0.80	0.40–0.65	1.40–2.00	0.40–0.65	...	0.85–1.20
Product analysis	0.46–0.84	0.36–0.69	1.34–2.06	0.36–0.69	...	0.79–1.26
Molybdenum:						
Heat analysis	0.18–0.28	0.15–0.25	0.40–0.60	0.40–0.60	0.50–0.65	0.45–0.60
Product analysis	0.15–0.31	0.12–0.28	0.36–0.64	0.36–0.64	0.46–0.69	0.41–0.64
Boron	0.0025 max	0.0005–0.005	0.001–0.005	0.0005–0.006	0.001–0.005	0.001–0.005
Vanadium:						
Heat analysis	...	0.03–0.08	<sup>B</sup>	0.03–0.08	...	...
Product analysis	...	0.02–0.09	...	0.02–0.09	...	...
Titanium:						
Heat analysis	...	0.01–0.03	0.01–0.10	...	...	...
Product analysis	...	0.01–0.04	0.005–0.11	...	...	...
Zirconium:						
Heat analysis	0.05 <sup>C</sup> –0.15	...	...	...	...	...
Product analysis	0.04–0.16	...	...	...	...	...
Copper:						
Heat analysis	...	...	...	0.15–0.50	...	...
Product analysis	...	...	...	0.12–0.53	...	...
Columbium, max						
Heat analysis	...	...	...	...	...	...
Product analysis	...	...	...	...	...	...

<sup>A</sup> Applied to both heat and product analyses.

<sup>B</sup> May be substituted for part or all of titanium content on a one for one basis.

<sup>C</sup> Zirconium may be replaced by cerium. When cerium is added, the cerium/sulfur ration should be approximately 1.5 to 1, based on heat analysis.

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Elements	Composition, %			
	Grade 55 [Grade 380]	Grade 60 [Grade 415]	Grade 65 [Grade 450]	Grade 70 [Grade 485]
Carbon, max <sup>A</sup> :				
½ in. [12.5 mm] and under	0.18	0.21	0.24	0.27
Over ½ in. to 2 in. [12.5 to 50 mm], incl	0.20	0.23	0.26	0.28
Over 2 in. to 4 in. [50 to 100 mm], incl	0.22	0.25	0.28	0.30
Over 4 to 8 in. [100 to 200 mm], incl	0.24	0.27	0.29	0.31
Over 8 in. [200 mm]	0.26	0.27	0.29	0.31
Manganese:				
½ in. [12.5] and under:				
Heat analysis <sup>B</sup>	0.60–0.90	0.60–0.90	0.85–1.20	0.85–1.20
Product analysis <sup>B</sup>	0.55–0.98	0.55–0.98	0.79–1.30	0.79–1.30
Over ½ in. [12.5]:				
Heat analysis	0.60–1.20	0.85–1.20	0.85–1.20	0.85–1.20
Product analysis	0.55–1.30	0.79–1.30	0.79–1.30	0.79–1.30
Phosphorus, max <sup>A</sup>	0.035	0.035	0.035	0.035
Sulfur, max <sup>A</sup>	0.035	0.035	0.035	0.035
Silicon:				
Heat analysis	0.15–0.40	0.15–0.40	0.15–0.40	0.15–0.40
Product analysis	0.13–0.45	0.13–0.45	0.13–0.45	0.13–0.45

<sup>A</sup> Applies to both heat and product analyses.

<sup>B</sup> Grade 60 plates ½ in. [12.5 mm] and under in thickness may have 0.85–1.20% manganese on heat analysis, and 0.79–1.30% manganese on product analysis.

SA-283/SA-283M

Elements	Heat Analysis, %			
	Grade A	Grade B	Grade C	Grade D
Carbon, max	0.14	0.17	0.24	0.27
Manganese, max	0.90	0.90	0.90	0.90
Phosphorus, max	0.035	0.035	0.035	0.035
Sulfur, max	0.04	0.04	0.04	0.04
Silicon				
Plates 1½ in. [40 mm] and under, max	0.40	0.40	0.40	0.40
Plates over 1½ in. [40 mm]	0.15–0.40	0.15–0.40	0.15–0.40	0.15–0.40
Copper, min % when copper is specified	0.20	0.20	0.20	0.20

SA-553/SA-553M

Element	Composition, %	
	Type I	Type II
Carbon, max <sup>A</sup>	0.13	0.13
Manganese, max:		
Heat analysis	0.90	0.90
Product analysis	0.98	0.98
Phosphorus, max <sup>A</sup>	0.035	0.035
Sulfur, max <sup>A</sup>	0.035	0.035
Silicon:		
Heat analysis	0.15–0.40	0.15–0.40
Product analysis	0.13–0.45	0.13–0.45
Nickel:		
Heat analysis	8.50–9.50	7.50–8.50
Product analysis	8.40–9.60	7.40–8.60

<sup>A</sup> Applies to both heat and product analyses.

SA-36/SA-36M

Product	Shapes <sup>A</sup>	Plates <sup>B</sup>					Bars			
		To ¾ [20], incl	Over ¾ to 1½ [20 to 40], incl	Over 1½ to 2½ [40 to 65], incl	Over 2½ to 4 [65 to 100], incl	Over 4 [100]	To ¾ [20], incl	Over ¾ to 1½ [20 to 40], incl	Over 1½ to 4 [100], incl	Over 4 [100]
Thickness, in. [mm]	All									
Carbon, max, %	0.26	0.25	0.25	0.26	0.27	0.29	0.26	0.27	0.28	0.29
Manganese, %	...	...	0.80–1.20	0.80–1.20	0.85–1.20	0.85–1.20	...	0.60–0.90	0.60–0.90	0.60–0.90
Phosphorus, max, %	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Sulfur, max, %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Silicon, %	0.40 max	0.40 max	0.40 max	0.15–0.40	0.15–0.40	0.15–0.40	0.40 max	0.40 max	0.40 max	0.40 max
Copper, min, % when copper steel is specified	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

<sup>A</sup> Manganese content of 0.85–1.35% and silicon content of 0.15–0.40% is required for shapes over 426 lb/ft [634 kg/m].

<sup>B</sup> For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum will be permitted up to the maximum of 1.35%.

SA-533/SA-533M

	Composition, %			
	Type A	Type B	Type C	Type D
Carbon, max <sup>A</sup>	0.25	0.25	0.25	0.25
Manganese <sup>B</sup> :				
Heat analysis	1.15–1.50	1.15–1.50	1.15–1.50	1.15–1.50
Product analysis	1.07–1.62	1.07–1.62	1.07–1.62	1.07–1.62
Phosphorus, max <sup>A</sup>	0.035	0.035	0.035	0.035
Sulfur, max <sup>A</sup>	0.035	0.035	0.035	0.035
Silicon:				
Heat analysis	0.15–0.40	0.15–0.40	0.15–0.40	0.15–0.40
Product analysis	0.13–0.45	0.13–0.45	0.13–0.45	0.13–0.45
Molybdenum:				
Heat analysis	0.45–0.60	0.45–0.60	0.45–0.60	0.45–0.60
Product analysis	0.41–0.64	0.41–0.64	0.41–0.64	0.41–0.64
Nickel:				
Heat analysis	...	0.40–0.70	0.70–1.00	0.20–0.40
Product analysis	...	0.37–0.73	0.67–1.03	0.17–0.43

<sup>A</sup> Applies to both heat and product analyses.

<sup>B</sup> The maximum manganese content may be increased to 1.60% on heat analysis and 1.65% on product analysis when Class 2 or Class 3 properties are specified and when Supplementary Requirement S3 (see Specification A 20/A 20M) is specified with a total holding time of more than 1 h/in. [2.4 min/mm] of thickness.

**SA-537/SA-537M**

Element	Composition, %
Carbon, max [Note (1)]	0.24
Manganese:	
1½ In. [40 mm] and under In thickness [Note (2)]	
Heat analysis	0.70–1.35
Product analysis	0.64–1.46
Over 1½ In. [40 mm] In thickness:	
Heat analysis	1.00–1.60
Product analysis	0.92–1.72
Phosphorus, max [Note (1)]	0.035
Sulfur, max [Note (1)]	0.035
Silicon:	
Heat analysis	0.15–0.50
Product analysis	0.13–0.55
Copper, max:	
Heat analysis	0.35
Product analysis	0.38
Nickel, max:	
Heat analysis	0.25
Product analysis	0.28
Chromium, max:	
Heat analysis	0.25
Product analysis	0.29
Molybdenum, max:	
Heat analysis	0.08
Product analysis	0.09

**NOTES:**

(1) Applies to both heat and product analyses.

(2) Manganese may exceed 1.35% on heat analysis, up to a maximum of 1.60%, and nickel may exceed 0.25% on heat analysis, up to a maximum of 0.50%, provided the heat analysis carbon equivalent does not exceed 0.57% when based upon the following equation:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

**SA-285/SA-285M**

Elements	Composition, %		
	Grade A	Grade B	Grade C
Carbon, max <sup>A</sup>	0.17	0.22	0.28
Manganese, max			
Heat analysis	0.90	0.90	0.90
Product analysis	0.98	0.98	0.98
Phosphorus, max <sup>A</sup>	0.035	0.035	0.035
Sulfur, max <sup>A</sup>	0.035	0.035	0.035

<sup>A</sup> Applied to both heat and product analysis.

Designation		Method of deoxidation b	C in % max. for nominal product thickness in mm			Si % max.	Mn % max.	P % max.	S % max.	N % max.	Cu % max.	Other % max.
According EN 10027-1 and CR 10260	According EN 10027-2		≤ 16	> 16 ≤ 40	> 40 <sup>c</sup>							
S235JR	1.0038	FN	0,17	0,17	0,20	-	1,40	0,035	0,035	0,012	0,55	-
S235J0	1.0114	FN	0,17	0,17	0,17	-	1,40	0,030	0,030	0,012	0,55	-
S235J2	1.0117	FF	0,17	0,17	0,17	-	1,40	0,025	0,025	-	0,55	-
S275JR	1.0044	FN	0,21	0,21	0,22	-	1,50	0,035	0,035	0,012	0,55	-
S275J0	1.0143	FN	0,18	0,18	0,18 <sup>i</sup>	-	1,50	0,030	0,030	0,012	0,55	-
S275J2	1.0145	FF	0,18	0,18	0,18 <sup>i</sup>	-	1,50	0,025	0,025	-	0,55	-
S355JR	1.0045	FN	0,24	0,24	0,24	0,55	1,60	0,035	0,035	0,012	0,55	-
S355J0	1.0553	FN	0,20 <sup>j</sup>	0,20 <sup>k</sup>	0,22	0,55	1,60	0,030	0,030	0,012	0,55	-
S355J2	1.0577	FF	0,20 <sup>j</sup>	0,20 <sup>k</sup>	0,22	0,55	1,60	0,025	0,025	-	0,55	-
S355K2	1.0596	FF	0,20 <sup>j</sup>	0,20 <sup>k</sup>	0,22	0,55	1,60	0,025	0,025	-	0,55	-
S450J0 <sup>l</sup>	1.0590	FF	0,20	0,20 <sup>k</sup>	0,22	0,55	1,70	0,030	0,030	0,025	0,55	<sup>m</sup>

<sup>a</sup> See 7.2.

<sup>b</sup> FN = rimming steels not permitted; FF = fully killed steel (see 6.2.2).

<sup>c</sup> For sections with nominal thickness > 100 mm the C content by agreement.

See option 26.

<sup>d</sup> For long products the P and S content can be 0,005 % higher.

<sup>e</sup> For long products the max. S content can be increased for improved machinability by 0,015 % by agreement if the steel is treated to modify the sulphide morphology and the chemical composition shows min. 0,0020 % Ca.

See option 27.

<sup>f</sup> The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % or alternatively min. 0,015 % acid soluble Al or if sufficient other N binding elements are present. In this case the N binding elements shall be mentioned in the inspection document.

<sup>g</sup> Cu content above 0,40 % may cause hot shortness during hot forming.

<sup>h</sup> If other elements are added, they shall be mentioned on the inspection document.

<sup>i</sup> For nominal thickness > 150 mm: C = 0,20 % max..

<sup>j</sup> For grades suitable for cold roll forming (see 7.4.2.2.3): C = 0,22 % max..

<sup>k</sup> For nominal thickness > 30 mm: C = 0,22 % max..

<sup>l</sup> Applicable for long products only.

<sup>m</sup> The steel may show a Nb content of max. 0,05 %, a V content of max. 0,13 % and a Ti content of max. 0,05 %.

Grade	GL-A 32	GL-D 32	GL-E 32	GL-A 36	GL-D 36	GL-E 36
Deoxidation practice	Fully killed and fine grain treated					
Chemical composition (%) ladle samples <sup>4)</sup>						
C <sub>max</sub>	0,18					
Mn	0,90 - 1,60 <sup>1)</sup>					
Si <sub>max</sub>	0,50					
P <sub>max</sub>	0,040					
S <sub>max</sub>	0,040					
Al (total) <sub>min</sub>	0,020 <sup>2)</sup>					
Nb	0,02 - 0,05 <sup>2)</sup>					
V	0,05 - 0,10 <sup>2)</sup>					
Ti <sub>max</sub>	0,02 <sup>3)</sup>					
Cu <sub>max</sub>	0,30					
Cr <sub>max</sub>	0,20					
Ni <sub>max</sub>	0,40					
Mo <sub>max</sub>	0,08					

} total max. 0,12

Grade	GL-A	GL-B	GL-D	GL-E
Deoxidation practice	Any method except rimmed steel <sup>1)</sup>	Any method except rimmed steel	For t ≤ 25 mm fully killed, for t > 25 mm fully killed and fine grain treated	fully killed and fine grain treated
Chemical composition (%) ladle sample <sup>4)</sup>	Carbon plus 1/6 of the manganese content is not to exceed 0,40 %			
C <sub>max</sub>	0,21 <sup>2)</sup>	0,21	0,21	0,18
Mn <sub>min</sub>	2,5 x C	0,80 <sup>3)</sup>	0,60	0,70
Si <sub>max</sub>	0,35	0,35	0,35	0,35
P <sub>max</sub>	0,040	0,040	0,040	0,040
S <sub>max</sub>	0,040	0,040	0,040	0,040
Al (total) min	-	-	0,020 <sup>5)</sup>	0,020
<sup>1)</sup> Grade GL-A sections up to a thickness of 12,5 mm may be accepted in rimmed steel subject to the special approval of the Society. <sup>2)</sup> Max. 0,23 % for sections. <sup>3)</sup> When Grade GL-B steel is impact tested the minimum manganese content may be reduced to 0,60 %. <sup>4)</sup> The Society may stipulate limits for accompanying elements which may adversely affect the working and use of the steel, e.g. copper and tin. <sup>5)</sup> For Grade GL-D steel over 25 mm thick.				