

JIS G3101 一般結構用鋼 Rolled Steels for General Structure

鋼種 Grade	化學成份 Chemical Compositions %					機械性質 Mechanical Properties									
						降伏點或降伏強度 N/mm ² Yield Point or Proof Stress			抗拉強度 Tensile Strength N/mm ²	鋼材厚度 Thickness T, mm	試片 Test piece	伸長率 Elongation %	彎曲性質 Bend property		
	鋼材厚度Thickness mm			彎曲角度 Angle of Bending	內側半徑 Inside Radius	試片 Test Piece									
	C	Si	Mn				P	S	≤16	>16 ≤40	>40				
SS400	—	—	—	0.050 max.	0.050 max.	245 min.	235 min.	215 min.	400 510	T ≤ 5	No. 5	21 min.	180°	厚度 × 1.5 1.5 times the thickness	No. 1
										5 < T ≤ 16	No. 1A	17 min.			
										16 < T ≤ 50	No. 1A	21 min.			
										T > 40	No. 4	23 min.			
SS490	—	—	—	0.050 max.	0.050 max.	285 min.	275 min.	255 min.	490 610	T ≤ 5	No. 5	19 min.	180°	厚度 × 2.0 2.0 times the thickness	No. 1
										5 < T ≤ 16	No. 1A	15 min.			
										16 < T ≤ 50	No. 1A	19 min.			
										T > 40	No. 4	21 min.			

註:1. 必要時可添加表列以外之合金元素

2. 除非客戶特別指定要做彎曲試驗，否則該項試驗可取消

Remarks:

1. Alloying elements other than those given in table may be added as necessary.

2. The bend test may be omitted unless otherwise specified by the purchaser.

JIS G3106 熔接結構用鋼 Rolled Steels for Welded Structure

鋼種 Grade	厚度Thickness T,mm	化學成份 Chemical Compositions %					機械性質 Mechanical Properties										
							降伏點或降伏強度 N/mm ²			抗拉 強度 Tensile Strength N/mm ²	鋼材厚度 Thickness T, mm	試片 Test Piece	伸長率 Elongation %	衝擊試驗 Impact test			試片 Test Piece
		C	Si	Mn	P	S	≤ 16	> 16 ≤ 40	> 40 ≤ 75					符號 Symbol	試驗溫度 Temperature °C	夏比 衝擊值 Charpy Absorption Energy J	
SM400A	≤ 50	0.23 max.	—	2.5xC min.						400 510	T ≤ 5	No. 5	23 min.	A	—	—	V槽試片 平行 軋延 方向 V-notch test piece rolling direction
	50 < T ≤ 100	0.25 max.									245 min.	235 min.	215 min.	5 < T ≤ 16	No. 1A	18 min.	
SM400B	≤ 50	0.20 max.	0.35 max.	0.60 1.50						490 610	16 < T ≤ 50	No. 1A	22 min.	C	0	47 min.	
	50 < T ≤ 100	0.22 max.									T > 40	No. 4	24 min.				
SM400C	≤ 100	0.18 max.		0.60 1.50													
SM490A	≤ 50	0.20 max.	0.55 max.	1.65 max.						490 610	T ≤ 5	No. 5	22 min.	A	—	—	
SM490B	50 < T ≤ 100	0.22 max.									325 min.	315 min.	295 min.	5 < T ≤ 16	No. 1A	17 min.	
	≤ 50	0.18 max.	16 < T ≤ 50	No. 1A	21 min.												
SM490C	50 < T ≤ 100	0.20 max.															
	≤ 100	0.18 max.	T > 40	No. 4	23 min.	C	47 min.										
SM490YA	≤ 100	0.20 max.									T ≤ 5	No. 5	19 min.	A	—	—	
SM490YB			365 min.	355 min.	335 min.	490 610	5 < T ≤ 16	No. 1A	15 min.								
			16 < T ≤ 50	No. 1A	19 min.	B	0	27 min.									
T > 40			No. 4	21 min.													
SM520B											T ≤ 5	No. 5	19 min.	B	0	27 min.	
SM520C	365 min.	355 min.	335 min.	520 640	5 < T ≤ 16	No. 1A	15 min.										
	16 < T ≤ 50	No. 1A	19 min.	C	47 min.												
T > 40	No. 4	21 min.															

註1.必要時可添加表列以外之合金元素。

2.衝擊試驗適用於厚度大於12mm之鋼料，且吸收能值為3個試片測試值之平均值。

Remarks: 1. Alloying elements other than those given in table may be added as necessary.

2. The steel products over 12mm in thickness shall be tested and the Charpy absorption energy shall be expressed by the average of measured values of three pieces.

鋼種 Grade	厚度 Thickness T mm	化學成份 Chemical Compositions %							機械性質 Mechanical Properties																			
		C	Si	Mn	P	S	碳當量 Carbon Equivalent (%)	焊裂敏 感度 Sensitivity of Welding Crack (%)	降伏點或降伏強度 N/mm ² Yield point or Proof stress				抗拉 強度 Tensile Strength N/mm ²	降伏比 Yield Ratio %				厚度方向特性 Through-thickness characteristics 收縮率 (Contraction %)		鋼材厚度 Thickness T, mm	試片 Test Piece	伸長率 Elongation %	衝擊試驗 Impact Test					
									鋼材厚度 Thickness mm					鋼材厚度 Thickness ,mm				鋼材厚度 Thickness T ,mm					符號 Symbol	試驗 溫度 Temp. °C	夏比 衝擊值 Energy J	試片 Test Piece		
									≥6 <12	≥12 <16	≥16 ≤40	>40 ≤100		≥6 <12	≥12 <16	≥16 ≤40	>40 ≤100	最小單值 (Minimum Individual Tested Value)	最小均值 (Minimum Average of Three Tested Value)								最小單值 (Minimum Individual Tested Value)	最小均值 (Minimum Average of Three Tested Value)
SN400A	6 ≤ T ≤ 100	0.24 max.	—	—	0.050 max.	0.050 max.	—	—	235 min.	235 min.	235 min.	215 min.	400 510	—	—	—	—	—	6 ≤ T ≤ 16	No. 1A	17 min.	A	—	—	—			
SN400B	6 ≤ T ≤ 50	0.20 max.	0.35 max.	0.60 1.40	0.030 max.	0.015 max.	—	—	235 min.	235 355	235 355	215 335	400 510	—	80 max.	—	—	6 ≤ T ≤ 16	No. 1A	18 min.	B					0	27 min.	—
	50 < T ≤ 100	0.22 max.																16 < T ≤ 50	No. 1A	22 min.								
SN400C	16 ≤ T ≤ 50	0.20 max.	0.35 max.	0.60 1.40	0.020 max.	0.008 max.	0.36 max.	0.26 max.	—	—	—	—	400 510	—	—	—	15	25	16 ≤ T ≤ 100	16 ≤ T ≤ 100	16	No. 1A	18 min.	C	0	27 min.	—	
SN400B MOD	50 < T ≤ 100	0.22 max.							6 ≤ T ≤ 50	No. 1A	22 min.	40 < T ≤ 100	No. 4	24 min.														
SN400B MOD	6 ≤ T ≤ 50	0.20 max.	0.35 max.	0.60 1.40	0.030 max.	0.015 max.	—	—	250 min.	250 355		—	—	400 510	—	80 max.	80 max.	—	—	6 ≤ T ≤ 16	No. 1A	20 min.	B	0	27 min.	—		
SN490B	50 < T ≤ 100	0.22 max.							16 < T ≤ 50	No. 1A	22 min.	40 < T ≤ 100	No. 4	24 min.														
SN490B	6 ≤ T ≤ 50	0.18 max.	0.55 max.	1.60 max.	0.030 max.	0.015 max.	0.29 max.	—	325 min.	325 445	—	—	490 610	—	80 max.	—	—	—	—	6 ≤ T ≤ 16	No. 1A	17 min.	B	0	27 min.	—		
SN490C	50 < T ≤ 100	0.20 max.							T ≤ 40mm 0.44 max.	T > 40mm 0.46 max.	325 min.	325 445	295 415	490 610														
SN490C	16 ≤ T ≤ 50	0.18 max.	0.55 max.	1.60 max.	0.020 max.	0.008 max.	0.29 max.	—	—	—	—	—	490 610	—	—	—	15	25	16 ≤ T ≤ 100	16 ≤ T ≤ 100	16	No. 1A	17 min.	C	0	27 min.	—	
SN490C	50 < T ≤ 100	0.20 max.							T ≤ 40mm 0.44 max.	T > 40mm 0.46 max.	—	—	—	—														

註:1.必要時可添加表列以外之合金元素。

2.碳當量(%)=C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

3.鐳裂敏感度(%)=C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B

4.在買賣雙方同意下，可用鐳裂敏感度取代碳當量。

Remarks:

1. Alloying elements other than those given in table may be added as necessary.

2. Carbon equivalent(%)=C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

3. Sensitivity of welding crack(%)=C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B

4. Chemical composition on sensitivity of welding crack may be applied instead of carbon equivalent subject to the agreement between the purchaser and supplier.

註:5.對於腹板厚度小於等於9mm之H型鋼，降伏強度的上限值不適用。

6.衝擊試驗適用於厚度大於12mm之鋼料，且吸收能量值為3個試片測試值之平均值。個別試片測試值可小於27J，但一定要大於19J。

7. SN400C與SN490C厚度大於16mm以上窄板須做超音波檢驗，檢驗規範依據JIS G 0901之Class Y定義。

Remarks:

5. For the H section, when t1 is 9mm or less, the upper limit of the yield point or proof stress shall not be applied.

6. The steel products over 12mm in thickness shall be tested and the Charpy absorption energy shall be expressed by the average of measured values of three test pieces. Further, one result among individual test results may be under 27J but shall be 19J or over.

7. For the Flat of SN400C and SN490C which thickness over 16mm, the UT(ultrasonic test) is required. According to the acceptance criteria,Class Y,specified in JIS G 0901.

ASTM A36 結構用碳鋼 Carbon Structural Steel

鋼種 Grade	產品別 Products	厚度 Thickness T,mm	化學成分Chemical Compositions%					機械性質 Mechanical Properties					
			C	Si	Mn	P	S	拉伸試驗 Tensile test					
								降伏點 Yield Point		抗拉強度 Tensile Strength		伸長率 Elongation %	
								Ksi	MPa	Ksi	MPa	試片GL=8in. [200mm]	試片GL=2in. [50mm]
A36	H型鋼 (shapes)	All	0.26 max.	0.40 max.	—	0.04 max.	0.05 max.	36 min.	250 min.	58 80	400 550	20 min.	21 min.
	鋼板 ⁽²⁾ (Plates)	≤20	0.25 max.	0.40 max.	—	0.04 max.	0.05 max.					20 min.	23 min.
		20 < T ≤ 40	0.25 max.	0.40 max.	0.80 1.20	0.04 max.	0.05 max.						
		40 < T ≤ 65	0.26 max.	0.15 0.40	0.80 1.20	0.04 max.	0.05 max.						

註:1. 指定為加銅鋼時，銅含量須在0.20%以上。

2. 當C含量規格最大值每減少0.01%時，Mn含量規格最大值可增加0.06%，但Mn含量規格最大值不可高於1.35%。

3. 當厚度小於8mm時，伸長率依ASTM A6規定得以遞減。

Remarks:

1. As for the Cu content, when specified shall have a minimum content of 0.20%.

2. For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum will be permitted, up to the maximum of 1.35%.

3. In according with ASTM A6, when using rectangular tension test specimen for testing thin material, adjustments in elongation requirements must be provided for thickness under 8mm.

ASTM A572 加鈮釩高強度低合金結構用鋼 High-Strength Low-Alloy Columbium-Vanadium Structure Steel

鋼種 等級 Grade	化學成份 Chemical Compositions %										機械性質 Mechanical Properties						
	C	Si	Mn ⁽⁵⁾	P	S	Type 1		Type 2		Type 3		拉伸試驗 Tensile Test					
						Nb	V	Nb	V	Nb+V	降伏點 Yield Point		抗拉強度 Tensile Strength		伸長率 Elongation %		
											ksi	MPa	ksi	MPa	試片 GL=8 in. [200mm]	試片 GL=2 in. [50mm]	
42 [290]	0.21 max.	0.40 ⁽⁶⁾ max.	1.35 max.	0.04 max.	0.05 max.	0.005 0.050	0.01 0.15	0.005 0.050	0.01 0.15	0.02 0.15	42 min.	290 min.	60 min.	415 min.	20 min.	24 min.	
50 [345]	0.23 max.	0.40 ⁽⁶⁾ max.	1.35 max.	0.04 max.	0.05 max.						50 min.	345 min.	65 min.	450 min.	18 min.	21 min.	
60 [415]	0.26 max.	0.40 max.	1.35 max.	0.04 max.	0.05 max.						60 min.	415 min.	75 min.	520 min.	16 min.	18 min.	

註: 1.指定為加銅鋼時，銅含量須在0.20%以上。

2.Mn/C比值不得小於2。

3.當C含量規格最大值每減少0.01%時，Mn含量規格最大值可增加0.06%，但Mn含量規格最大值不可高於1.60%。

4.當厚度小於8mm時，伸長率依ASTM A6規定得以遞減。

5.當鋼板厚度超過10mm時，Mn含量不得低於0.80%；鋼板和其它產品厚度在10mm以下時，Mn含量最低值為0.50%。

6.鋼板厚度40mm以上時，Si含量最低值為0.15%。

Remarks:

1. As for the Cu content, when specified shall have a minimum content of 0.20%.

2. The manganese to carbon ratio shall not be less than 2 to 1.

3. For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum will be permitted, up to the maximum of 1.60%.

4. In according with ASTM A6, when using rectangular tension test specimen for testing thin material, adjustments in elongation requirements must be provided for thickness under 8mm

5. Manganese, minimum, by heat analysis of 0.80% shall be required for all plates over 10mm in thickness ;
a minimum of 0.50% shall be required for plates 10mm and less in thickness, and for all other products.

6. Silicon, minimum, by heat analysis of 0.15% shall be required for all plates over 40mm in thickness.

ASTM A709 橋樑結構用鋼 Structural Steel for Bridges

鋼種 等級 Grade	化學成份 Chemical Compositions %												機械性質 Mechanical Properties																				
	C	Si	Mn	P	S	V	Nb	Cu	Ni	Cr	Mo	碳當量 ⁽¹⁰⁾ Carbon Equivalent , CE (%)	拉伸試驗 Tensile Test				衝擊試驗 Impact test ^{(6)·(8)·(9)}																
													降伏點 Yield Point	抗拉強 度 Tensile Strength	伸長率 ⁽⁷⁾ Elongation %		降伏比 Yield Ratio	鋼材厚 度 Thickness mm	符號 Symbol	最低試驗值 Min. Test Value Energy J	Zone 1		Zone 2		Zone 3		符號 Symbol	Zone 1		Zone 2		Zone 3	
															MPa	MPa					試片 GL=8 in. [200mm]	試片 GL=2 in. [50mm]	%	試驗 溫度 Temp. °C	夏比 衝擊值 Charpy Energy J	試驗 溫度 Temp. °C		夏比 衝擊值 Charpy Energy J	試驗 溫度 Temp. °C	夏比 衝擊值 Charpy Energy J	試驗 溫度 Temp. °C	夏比 衝擊值 Charpy Energy J	試驗 溫度 Temp. °C
50	0.23 max.	0.40 max.	1.35 max.	0.04 max.	0.050 max.	Type 2		0.20 ⁽¹⁾ min.	—	—	—	—	345 min.	450 min.	18 min.	21 min.	—	≤ 50	F	27 min.	21	34 min.	4	34 min.	-12	34 min.	T	21	20 min.	4	20 min.	-12	20 min.
						> 50 ≤ 100	33 min.											21		41 min.	4	41 min.	-12	41 min.	21	27 min.		4	27 min.	-12	27 min.		
50S ⁽⁴⁾	0.23 max.	0.40 max.	0.50 ⁽³⁾ 1.60	0.035 max.	0.045 ⁽³⁾ max.	0.15 ⁽²⁾ max.	0.05 ⁽²⁾ max.	0.60 max.	0.45 max.	0.35 max.	0.15 max.	T ≤ 50mm 0.45 max.	345 450	450 min.	18 min.	21 min.	85 ⁽⁵⁾ max.	≤ 50	F	27 min.	21	34 min.	4	34 min.	-12	34 min.	T	21	20 min.	4	20 min.	-12	20 min.
												T > 50mm 0.47 max.						> 50 ≤ 100		33 min.	21	41 min.	4	41 min.	-12	41 min.		21	27 min.	4	27 min.	-12	27 min.

註:1.指定為加銅鋼時，銅含量須在0.20%以上。

2.釩與鈮共用時，最多不可超過0.15%。當C含量規格最大值每減少0.01%時，Mn含量規格最大值可增加0.06%，但Mn含量規格最大值不可高於1.60%。

3.Mn/S比值不可低於20/1。當厚度小於25mm時，Mn的含量須大於0.30%。Mn/C比值不得小於2。

4.煉鋼製程中若添加固氮元素時，N濃度可達150ppm，若沒添加固氮元素，其N濃度不能超過120ppm。

5.試片若取在翼板則降伏比須小於0.85;若試片取於腹板位置，則降伏比須小於0.87。

6.除非客戶指定，否則不必進行衝擊試驗及超音波試驗。

7.當厚度小於8mm時，伸長率依ASTM A6規定得以遞減。

8.採購訂單有衝擊試驗要求，需於訂購前告知使用非臨界斷裂(F)或臨界斷裂(T)之試驗方式。

9.50F與50SF衝擊試驗取樣頻率依據A673/A673M規定之P頻率內容;50T與50ST試驗取樣 頻率依據A673/A673M規定之H頻率內容。

10.碳當量=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15。

Remarks:

1.Copper when specified shall have a minimum content of 0.20%.

2.The sum of columbium and vanadium shall not exceed 0.15%.For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum will be permitted , up to the maximum of 1.60%.

3.Provided that the ratio of manganese to sulfur is not less than 20 to 1. the minimum limit for manganese for shapes with flange thickness nto exceeding 25mm shall be 0.30%.The manganese to carbon ratio shall not be less than 2 to 1.

4.The steelmaking practice used shall be one that produces steel having a nitrogen content not greater than 0.015% and includes the addition of one or more nitrogen-binding elements, or one that produces steel having a nitrogen content not greater than 0.012%.

5.The yield to tensile ratio shall be 0.87 or less for shapes that are tested from web location; for all other shapes the requirement is 0.85.

6.Impact test and Ultrasonic Examination shall not be tested unless specified in the purchase order or contract.

7.In according with ASTM A6, when using rectangular tension test specimen for testing thin material, adjustments in elongation requirements must be provided for thickness under 8mm.

8.Purchase orders have impact test requirements. Before ordering need to inform the use of non-critical-fracture ,T, or critical fracture,F.
9.The grade 50F & 50SF for the CVN-impact testing shall be at "P" frequency in accordance with Specification of A673/A673M; the grade 50T & 50ST for the CVN-impact testing shall be at "H" frequency in accordance with Specification of A673/A673M.

10.The carbon equivalent shall be calculated using the following formula : CE=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

ASTM A992 結構用型鋼 Structure Steel Shapes

鋼種 等級 Grade	化學成份 Chemical Compositions %												機械性質 Mechanical Properties							
	C	Si	Mn ⁽¹⁾	P	S	Cu	Ni	Cr	Mo	V ⁽²⁾	Nb ⁽²⁾	N ⁽³⁾	碳當量 Carbon Equivalent, CE (%)	拉伸試驗 Tensile Test						
														降伏點 Yield Point		抗拉強度 Tensile Strength		伸長率 Elongation %		降伏比 Yield Ratio
A992	0.23 max.	0.40 max.	0.50 1.60	0.035 max.	0.045 max.	0.60 max.	0.45 max.	0.35 max.	0.15 max.	0.15 max.	0.05 max.	0.012 max.	T ≤ 50mm 0.45 max.	ksi	MPa	ksi	MPa	試片 GL=8 in. [200mm]	試片 GL=2 in. [50mm]	%
													T > 50mm 0.47 max	50 65	345 450	65 min.	450 min.	18 min.	21 min.	85 max.

- 註: 1.如果Mn/S的比值不小於20，則型鋼厚度不超過25mm，Mn的下限可以改為0.30%。
 2.Nb+V的總和不得高於0.15%。
 3.煉鋼製程中若添固氮元素時，N濃度可達150ppm，若沒添加固氮元素，其N濃度不能超過120ppm。
 4.碳當量=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15。
 5.若取腹板位置做試驗，則最大降伏強度可達70ksi[480MPa]。
 6.若取腹板位置做試驗，則最大降伏比可達0.87。
 7.當厚度小於8mm時，伸長率依ASTM A6規定得以遞減。

Remarks:

1. Provided that the ratio of manganese to sulfur is not less than 20 to 1, the minimum limit for manganese for shapes with flange or leg thickness not exceeding 1 in. [25mm] shall be 0.30%.
2. The sum of columbium and vanadium shall not exceed 0.15%.
3. The steelmaking practice used shall be one that produces steel having a nitrogen content not greater than 0.015% and includes the addition of one or more nitrogen-binding elements, or one that produces steel having a nitrogen content not greater than 0.012%.
4. The carbon equivalent shall be calculated using the following formula:

$$CE = C + (Mn)/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$
5. A maximum yield strength of 70ksi [480MPa] is permitted for structure shapes that are required to be tested from the web location.
6. A maximum ratio of 0.87 is permitted for structural shapes that are tested from the web location.
7. In accordance with ASTM A6, when using rectangular tension test specimen for testing thin material, adjustments in elongation requirements must be provided for thickness under 8mm.

BS EN 10025-2(2004) 熱軋結構鋼 Hot Rolled Products of Structural Steels

鋼種 Grade	厚度 Thickness s T,mm	化學成份 Chemical Compositions %										機械性質 Mechanical Properties															
		C	Si	Mn	P	S	N	Cu	Nb	V	Ti	最大碳當量 Max. Carbon Equivalent Value, CEV (%)		降伏強度 Yield Strength MPa			抗拉強度 Tensile Strength MPa	最小伸長率 Percentage Elongation %		衝擊試驗 Charpy Impact Test							
												厚度區間 Nominal Thickness (mm)															
												≤30	30 < T ≤ 40	40 < T ≤ 63	≤ 16	16 < T ≤ 40	40 < T ≤ 63	3 ≤ T ≤ 100	3 ≤ T ≤ 40			40 < T ≤ 63	試驗溫度 Test Temp.(°C)	衝擊值 Min. Test Value(J)			
S275JR	T ≤ 40	0.21 max.	—	1.50 max.	0.035 max.	0.035 max.	0.012 max.	0.55 max.	—	—	—	0.40	0.40	0.42	275 min.	265 min.	255 min.	410 560	23	22	20	27					
	T > 40	0.22 max.	—	1.50 max.	0.035 max.	0.035 max.	0.012 max.	0.55 max.	—	—	—	0.40	0.40	0.42	275 min.	265 min.	255 min.	410 560	23	22	0	27					
S275J0	T < 63	0.18 max.	—	1.50 max.	0.030 max.	0.030 max.	0.012 max.	0.55 max.	—	—	—	0.40	0.40	0.42	275 min.	265 min.	255 min.	410 560	23	22	0	27					
S355JR	T < 63	0.24 max.	0.55 max.	1.60 max.	0.035 max.	0.035 max.	0.012 max.	0.55 max.	—	—	—	0.45	0.47	0.47	355 min.	345 min.	335 min.	470 630	22	21	20	27					
S355J0	T ≤ 30	0.20 max.	0.55 max.	1.60 max.	0.030 max.	0.030 max.	0.012 max.	0.55 max.	—	—	—	0.45	0.47	0.47	355 min.	345 min.	335 min.	470 630	22	21	0	27					
	T > 30	0.22 max.	0.55 max.	1.60 max.	0.030 max.	0.030 max.	0.012 max.	0.55 max.	—	—	—	0.45	0.47	0.47	355 min.	345 min.	335 min.	470 630	22	21	0	27					
S355J2	T ≤ 30	0.20 max.	0.55 max.	1.60 max.	0.025 max.	0.025 max.	—	0.55 max.	—	—	—	0.45	0.47	0.47	355 min.	345 min.	335 min.	470 630	22	21	- 20	27					
	T > 30	0.22 max.	0.55 max.	1.60 max.	0.025 max.	0.025 max.	—	0.55 max.	—	—	—	0.45	0.47	0.47	355 min.	345 min.	335 min.	470 630	22	21	- 20	27					
S450J0 ⁽¹⁾	T ≤ 30	0.20 max.	0.55 max.	1.70 max.	0.030 max.	0.030 max.	0.025 max.	0.55 max.	0.05 max.	0.13 max.	0.05 max.	0.47	0.49	0.49	450 min.	430 min.	410 min.	550 720	17	17	0	27					
	T > 30	0.22 max.	0.55 max.	1.70 max.	0.030 max.	0.030 max.	0.025 max.	0.55 max.	0.05 max.	0.13 max.	0.05 max.	0.47	0.49	0.49	450 min.	430 min.	410 min.	550 720	17	17	0	27					

註:1. P與S含量上限可上調0.005%。

2. S355J0與S450J0厚度大於30mm時，C=0.22max。

3. 碳當量=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15。

4. 厚度小於6mm不須做衝擊試驗。

5. 伸長量之標距L=5.65√A時之最小伸長率。(A:試片截面積)

Remarks:

1. For long products the P and S content can be 0.005% higher.

2. For the grade of S355J0 and S450J0, when thickness over 30mm, the maximum carbon content is 0.22%.

3. Carbon equivalent value(CEV)=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

4. Impact tests shall not be required for normal thickness less than 6mm.

5. Minimum elongation on L=5.65√A. (A: cross area of test piece)

船用高強度鋼材 Higher Strength Hull Structural Steel

鋼種 等級 Grade	化學成份 Chemical Compositions %													機械性質 Mechanical Properties						
	C	Si	Mn ⁽⁵⁾	P	S	V ⁽³⁾⁽⁴⁾	Nb ⁽³⁾⁽⁴⁾	Ti ⁽³⁾⁽⁴⁾	Cu	Cr	Mo	Ni	Al ⁽²⁾	碳當量 Carbon Equivalent,CE (%)	拉伸試驗 Tensile Test			衝擊試驗 Impact Test		
															降伏點 Yield Point N/mm ² (MPa)	抗拉強度 Tensile Strength N/mm ² (MPa)	伸長率 ⁽¹⁾ Elongation %	試驗 溫度 Temp. °C	夏比 衝擊值 Energy J	試片 方向
AH32	0.18 max.	0.10 0.50	0.90 1.60	0.035 max.	0.035 max.	0.05 0.10	0.02 0.05	0.02 max.	0.35 max.	0.20 max.	0.08 max.	0.40 max.	0.015 min.	T ≤ 50mm 0.36 max. 50 < T ≤ 70mm 0.38 max.	315 min.	440 590	22 min.	0	T ≤ 50mm 31min. 50 < T ≤ 70mm 38 min.	V槽試片平行 軋延方向 V-notch test piece Rolling Direction
DH32	0.18 max.	0.10 0.50	0.90 1.60	0.035 max.	0.035 max.	0.05 0.10	0.02 0.05	0.02 max.	0.35 max.	0.20 max.	0.08 max.	0.40 max.	0.015 min.	T ≤ 50mm 0.36 max. 50 < T ≤ 70mm 0.38 max.	315 min.	440 590	22 min.	-20	T ≤ 50mm 31 min. 50 < T ≤ 70mm 38 min.	
AH36	0.18 max.	0.10 0.50	0.90 1.60	0.035 max.	0.035 max.	0.05 0.10	0.02 0.05	0.02 max.	0.35 max.	0.20 max.	0.08 max.	0.40 max.	0.015 min.	T ≤ 50mm 0.38 max. 50 < T ≤ 70mm 0.40 max.	355 min.	490 620	21 min.	0	T ≤ 50mm 34 min. 50 < T ≤ 70mm 41 min.	
DH36	0.18 max.	0.10 0.50	0.90 1.60	0.035 max.	0.035 max.	0.05 0.10	0.02 0.05	0.02 max.	0.35 max.	0.20 max.	0.08 max.	0.40 max.	0.015 min.	T ≤ 50mm 0.38 max. 50 < T ≤ 70mm 0.40 max.	355 min.	490 620	21 min.	-20	T ≤ 50mm 34 min. 50 < T ≤ 70mm 41 min.	

註:1.各國船用型鋼化學與物性要求依各驗船協會規定。

2.使用全鋁含量不得低於0.020%;表中之可溶酸鋁可替代全鋁,其含量不可低於0.015%

3.Nb+V+Ti含量不可高於0.12%

4.鋼材得含有單一或複合之鋁、鉬與鈮或其它細晶粒化元素,採用單一細晶粒化元素者,其含量應依上表所規定數值。如採用複合元素細晶粒者,得免依上表所規定數值。

5.鋼材厚度不超過12.5mm時,其最低錳含量可減至0.70%。

6.伸長量之標距L=5.65√A時之最小伸長率。(A:試片截面積)

7.碳當量=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15。

Remarks:

1. The chemical compositions and mechanical properties of hull structure steel are specified in each Shipping Association.

2. The total Aluminum content may be determined instead of the acid soluble content. In such cases, the total Aluminum content is be not less than 0.020%.

3. If niobium, Vanadium and Titanium are used in combination, the combined total shall be less than 0.12%.

4. The steel is to contain Aluminum, Niobium and Vanadium or other suitable grain refining elements, either singly or in any combination. When used singly the steel is to contain the specified minimum content of the grain refining element. When used in combination, the specified minimum content of each gain refining element is not applicable.

5. Up to a thickness of 12.5mm the minimum Manganese content may be reduced to 0.7%.

6. Minimum elongation on L=5.65√A. (A: cross area of test piece)

7. Carbon equivalent value(CE)=C+(Mn)/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

AS/NZS 3679.1:2010 熱軋結構型鋼 Structural Steel Hot Rolled Sections

鋼種 等級 Grade	化學成份 Chemical Compositions %														機械性質 Mechanical Properties					
	C	Si	Mn	P	S	V ⁽³⁾⁽⁴⁾	Nb ⁽³⁾⁽⁴⁾	Nb+V ⁽³⁾⁽⁴⁾	Ti ⁽¹⁾⁽³⁾⁽⁴⁾	Cu ⁽²⁾	Ni ⁽²⁾	Cr ⁽²⁾	Mo ⁽²⁾	碳當量 Carbon Equivalent CE %	拉伸試驗 Tensile test					
															降伏應力 Yield Stress N/mm ² (MPa)				抗拉強度 Tensile Stress N/mm ² (MPa)	伸長率 ⁽⁷⁾ Elongation %
															鋼材厚度 Thickness, mm					
< 11	≥ 11 ≤ 17	> 17 < 40	≥ 40																	
300	0.25 max.	0.50 max.	1.60 max.	0.040 max.	0.040 max.	0.030 max.	0.020 max.	0.030 max.	0.040 max.	0.50 max.	0.50 max.	0.30 max.	0.10 max.	0.44	320 min.	300 min.	280 min.	280 min.	440 min.	22 min.
350 ⁽⁵⁾	0.22 max.	0.50 max.	1.60 max.	0.040 max.	0.040 max.	—	—	—	—	0.50 max.	0.50 max.	0.30 max.	0.10 max.	0.45	360 min.	340 min.	340 min.	330 min.	480 min.	20 min.

註:1.使用細晶元素鋁與鈦時，其總量不得超過0.15%，若單獨使用不可超過上表中各別管制量。

2.銅、鎳、鉻與鉬加總量不得超過1.00%。

3.300鋼種厚度小於15mm時，鈦、鈮、釩與鈮釩混加不視為微量合金添加元素，厚度超過15mm時單獨使用不可超過上表中各別管制量。

4.300鋼種在厚度大於等於15mm時，微合金元性總合最大含量不得大於0.15%且各別微合金含量最大值如上表所列，對所使用之微量合金元素必須顯示於品質證明書上。

5.350鋼種微合金元素Nb、V與Ti總合最大含量不得大於0.15%。

6.碳當量=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15

7.最小伸長率之標點距離長度為=5.65√A。

Remarks:

1.Grain refining elements, i.e. aluminium and titanium may be added, provided that the total content does not exceed 0.15%.

2.The Cu, Ni, Cr and Mo elements may be present to the limits stated, subject to a maximum total of 1.0%.

3.For grade 300 the thickness less than 15mm, titanium, niobium, vanadium and niobium plus vanadium are not considered as microalloying elements. The limit content lists as above table.

4.For grade 300 the thickness greater than or equal to 15mm, the maximum combined micro-alloying element content is 0.15%. Where micro-alloying elements are used, the percentage of each element is to be shown on the certificates.

5.For grades 350, micro-alloying elements niobium, vanadium and titanium may be added, provided that their total combined content does not exceed 0.15%.

6.Carbon equivalent(CE) is calculated from the following equation. CE=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15

7.Minimum elongation on a gauge length of 5.65√A.

CNS 13812 建築結構用鋼 Rolled Steel for Building Structure

鋼種 Grade	厚度 Thickness T mm	化學成份 Chemical Compositions %					機械性質 Mechanical Properties												
		C	Si	Mn	P	S	碳當量 Carbon Equivalent (%)	焊裂敏 感度 Sensitivity of Welding Crack (%)	降伏點或 降伏強度 Yield point or Proof stress (N/mm ²)	抗拉 強度 Tensile Strength (N/mm ²)	降伏比 Yield Ratio(%))	厚度方向特性 Through-thickness		鋼材厚度 Thickness T, mm	試片 Test Piece	伸長率 Elongation %	衝擊試驗 Impact Test		
												最小單值% (Minimum Individual Tested Value)	最小均値% (Minimum Average of Three Tested Value)				試驗 溫度 Temp. °C	夏比(沙丕) 衝擊值 Energy J	試片 Test Piece
SN490YB	16 ≤ T ≤ 40	0.18 max.	0.55 max.	1.60 max.	0.030 max.	0.015 max.	0.44max.	0.29 max.	325 445	490 610	80 max.	—	—	6 ≤ T ≤ 16	No. 1A	17 min.	0	27 min.	V槽試片 平行 軋延 方向 V-notch test piece rolling direction
	40 < T ≤ 100						0.46max.							16 < T ≤ 40	No. 1A	21 min.			
	40 < T ≤ 100						No. 4							23 min.					
SN490YC	16 ≤ T ≤ 40	0.18 max.	0.55 max.	1.60 max.	0.020 max.	0.008 max.	0.44max.	0.29 max.	325 445	490 610	80 max.	15	25	6 ≤ T ≤ 16	No. 1A	17 min.	0	27 min.	V槽試片 平行 軋延 方向 V-notch test piece rolling direction
	40 < T ≤ 100						0.46max.							16 < T ≤ 40	No. 1A	21 min.			
	40 < T ≤ 100						No. 4							23 min.					

註:1. 必要時可添加表列以外之合金元素。

2. 碳當量(%)=C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14
3. 鉍裂敏感度(%)=C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B
4. 在買賣雙方同意下，可用鉍裂敏感度取代碳當量。
5. 衝擊試驗適用於厚度大於12mm之鋼料，且吸收能量值為3個試片測試值之平均值。個別試片測試值可小於27J，但一定要大於19J。
6. 厚度16mm以上之SN490YC窄板須做超音波檢驗，依CNS 12845規定。

Remarks:

1. Alloying elements other than those given in table may be added as necessary.
2. Carbon equivalent(%)=C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14
3. Sensitivity of welding crack(%)=C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B
4. Chemical composition on sensitivity of welding crack may be applied instead of carbon equivalent subject to the agreement between the purchaser and supplier.
5. The steel products over 12mm in thickness shall be tested and the Charpy absorption energy shall be expressed by the average of measured values of three test pieces. Further, one result among individual test results may be under 27J but shall be 19J or over.
6. For the Flat of grade SN490YC which thickness over 16mm , the UT(ultrasonic test) is required. According to the acceptance criteria,CNS 12845.