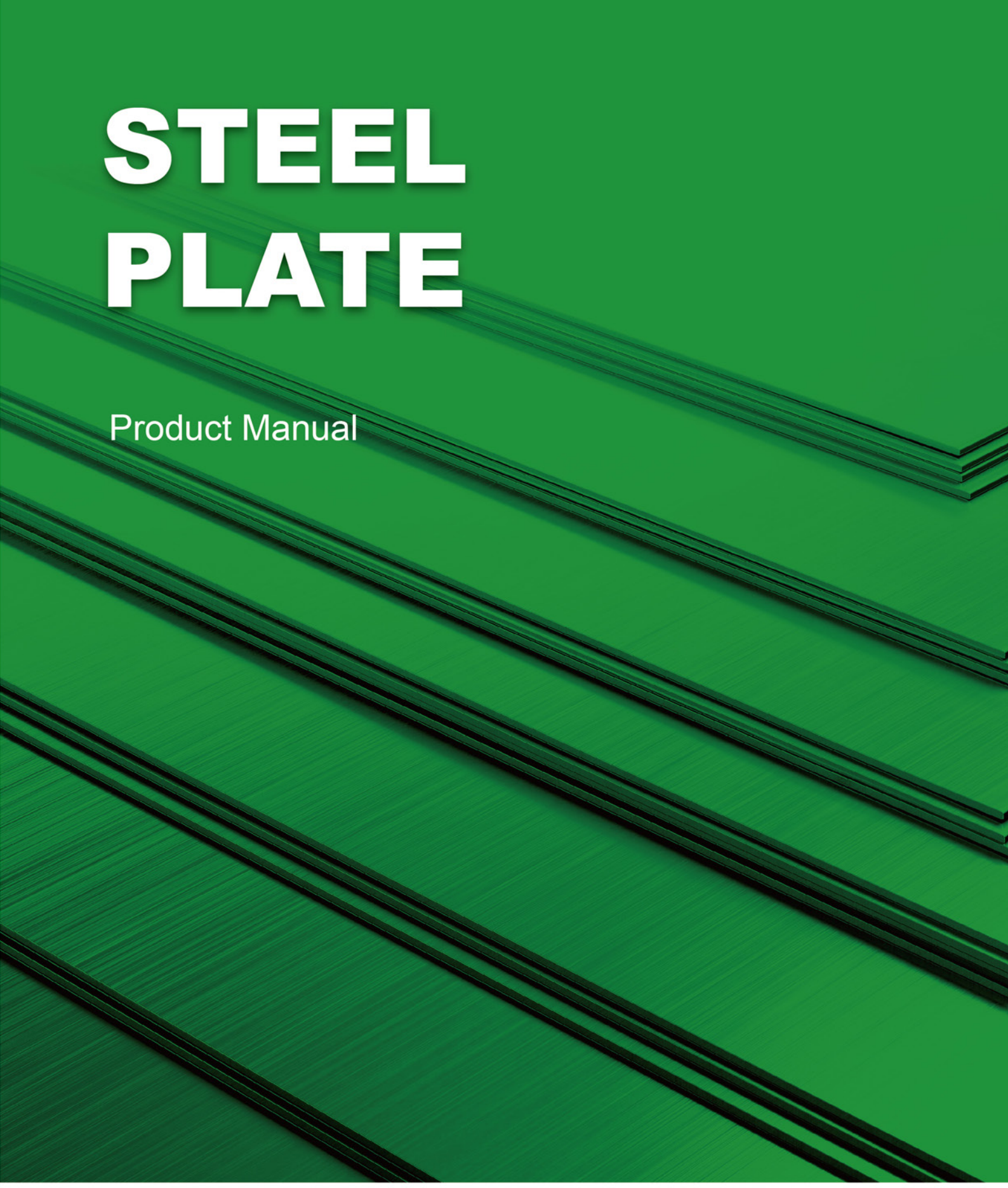
STEEL PLATE

Product Manual



CSC

STEEL PLATE

CSC

The quality policy of China Steel Corporation

China Steel Corporation, based-on customer orientation, will incessantly innovate, research & develop to provide excellent and eco-friendly products, and consequently fulfill our responsibility to society.

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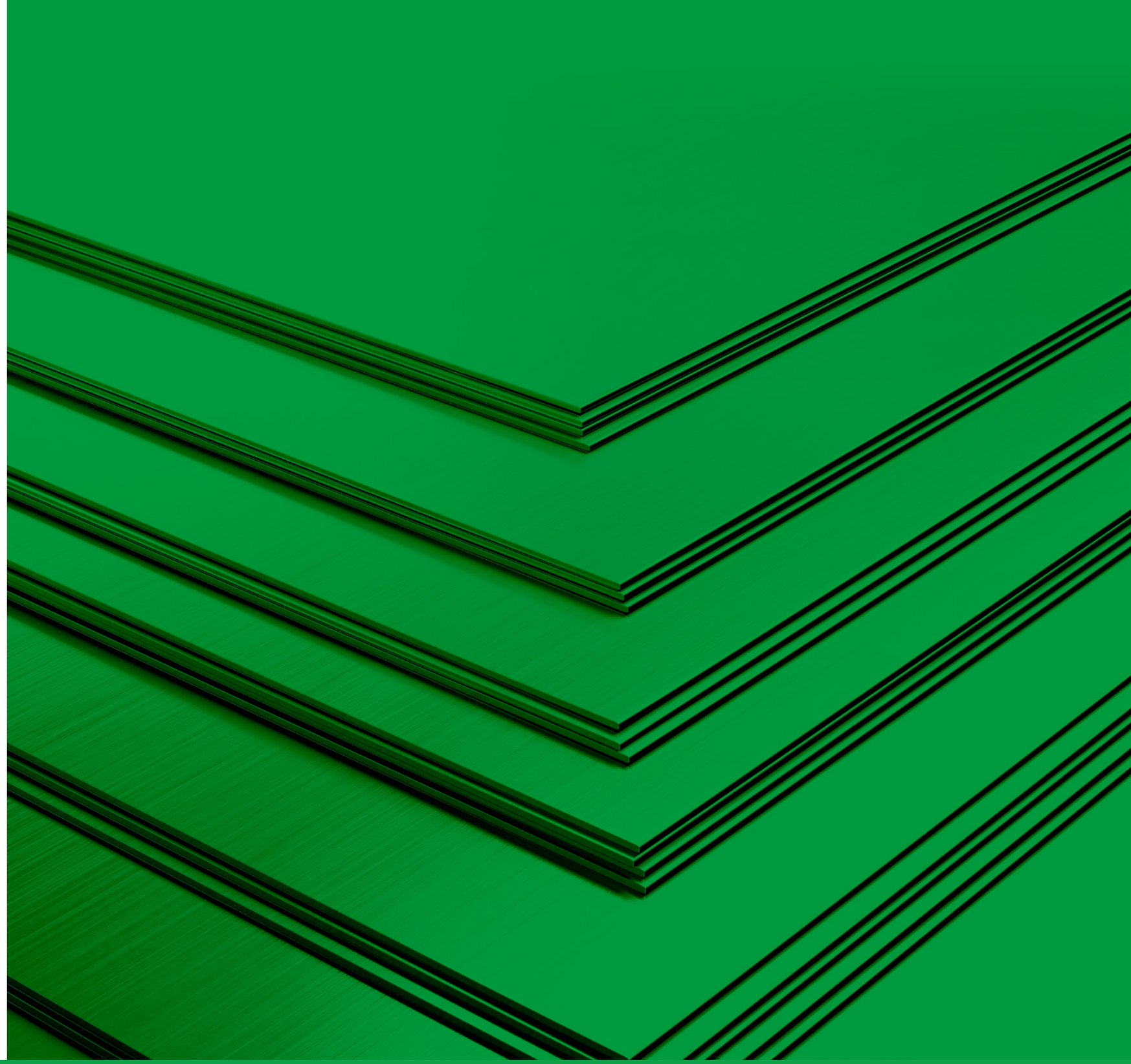
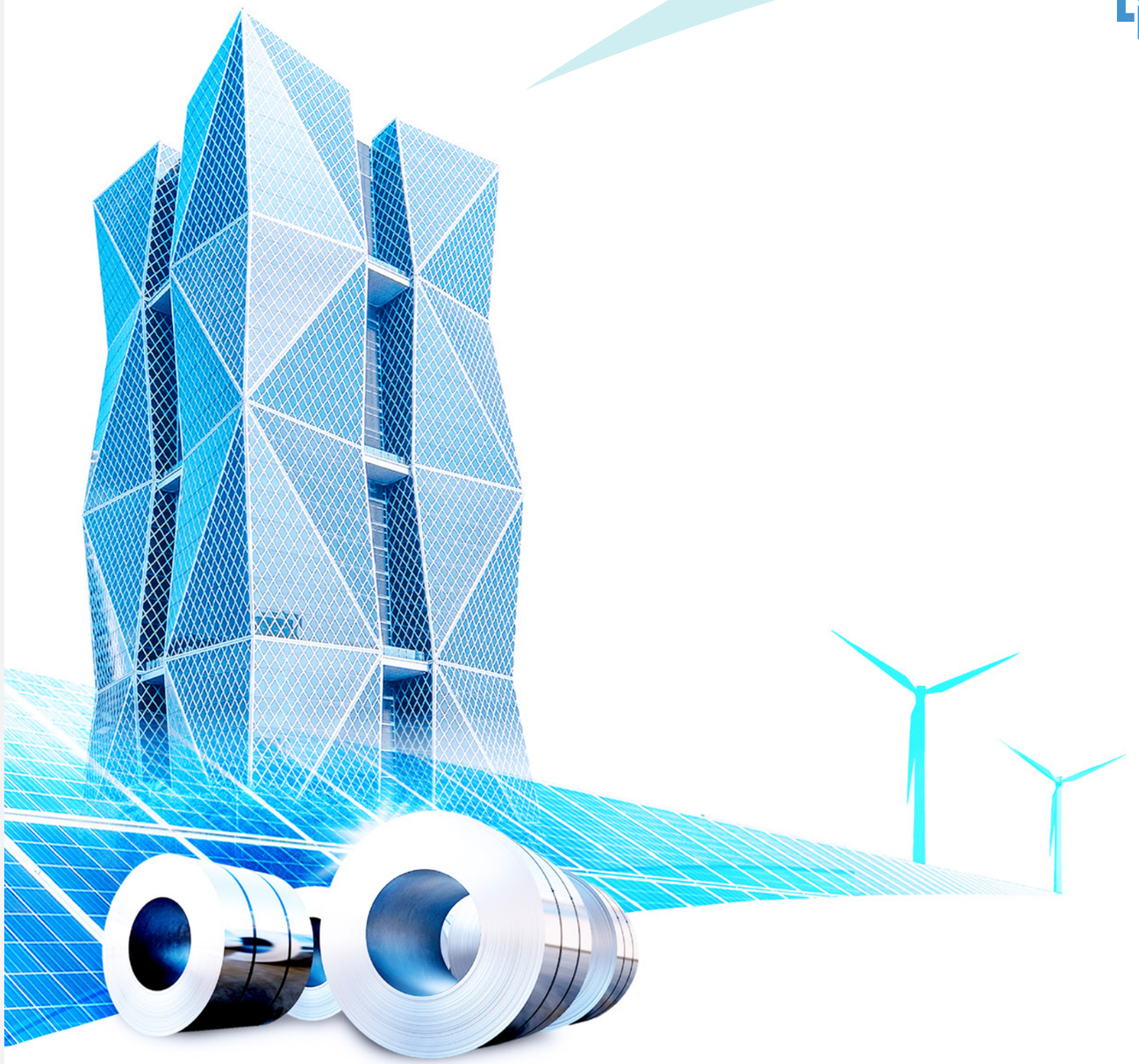




CSC

Vision

Smart Innovation / Green Energy / Value Co-creation

We aspire to be a sustainable growth enterprise.

China Steel Corporation (CSC), located in Kaohsiung, Taiwan, was established in December 1971. Its annual output of crude steel is about 10 million metric tons. The main products are steel plates, bars, wire rods, hot-rolled and cold-rolled coils, electrogalvanized coils, electrical steel coils, and hot-dip galvanized steel coils. It is currently the largest domestic steel manufacturer with a domestic market share of more than 50%. About 55.2% of its products are domestically consumed and 44.8% exported mostly to Southeast Asia, Europe and Japan.

CSC is very active in innovation and has strong capability to put the innovations into practice. The company's vision is “We aspire to be a sustainable growth enterprise that distinguishes itself through a firm commitment to smart innovation, green energy, carbon reduction, and value co-creation.” CSC actively puts in practice its corporate values of “teamwork, entrepreneurial approach, down-to-earthness and pursuit of innovation”, as well as its operational concepts of “promotion of social well-being, result orientation, implementation of teamwork, and emphasis on employees' self-realization.” Apart from continuing to cultivate in the steel industry, CSC is also committed to assisting the related downstream industries to upgrade and enhance the overall international competitiveness of the steel industry.

To become a steel mill that produces advanced premium products with high value

To develop the green energy industry

- Digital Transition
- Low-carbon Transition
- Supply Chain Transition

China Steel Corporation (CSC) is an integrated steel producer that has produced steel plates since the commencement of its plate mill. Through developments and improvements over the years, CSC's comprehensive steel plate grades have fulfilled industrial requirements demanded by general structure and building applications such as earthquake resistance, weather resistance, corrosion resistance, fire resistance, bridge and welding, as well as other uses like construction of ships, pressure vessels, line pipes, HIC resistance, laser-cutting, etc.

Much emphasis has placed on product safety standards. As surrounding conditions change, the quality and reliability of the steel become increasingly important. If quality fails, accidents and severe consequences may result. Therefore, besides selecting the proper type of steel plate, it is also crucial for a steel producer to adopt proper design, process equipment, production conditions and quality control demanded by customer's requirements and specifications in order to ensure quality and stability.

CSC has obtained ISO 9001, IATF 16949, and IECQ QC 080000 certifications. To meet the specific usage requirements of CSC's customers, certain steel plate products have obtained various country certifications, including those from Classification Societies (ABS, BV, CR, DNV, LR, and NK), Japan's JIS Mark, the European Union & UK (Construction Products Regulation, or CPR), Thailand's TISI, and Taiwan's CNS Mark. Additionally, CSC regularly outsources the testing of the chemical composition of steel products to ensure compliance with relevant international regulations on restricted hazardous substances. As a result, CSC's products are of excellent quality and can be trusted, providing customers with the assurance to use them confidently.

The vision of CSC's customer services is to gain customers' appreciation and trust and help them be successful, and the aim of that is to promote customers' technology and upgrade the steel industry. In order to enhance the customer services, CSC adopts multi-step and multi-level service pattern which is characterized by emphasizing on (1) the pre-sale services for helping customers to choose suitable materials and improve their production processes; (2) handling complains and claims from customers with proper and rapid manner, and conducting customers the corresponding improvements to the root-causes; (3) providing customers with the developed high-grade materials to meet the upgrade policy for domestic industries.

The stable and reliable quality of CSC's steel products have gained the acceptance of domesticindustries widely, and CSC has also been selected as the first priority provider to purchase their needed steel materials owing to CSC's quick and efficient technical services. CSC will continue to improve customer services and the technical technologies both for customers and CSC itself to promote steel-use industries' international competitiveness.

CSC PA400H、PA500H、AR400F
abrasion resistant steel plate

The abrasion resistant steel plates from CSC are produced using direct quenching and tempering process, offering excellent abrasion resistance and machinability. It's suitable for components such as silos, buckets, and crushers, helping to extend the service life of heavy machinery. The PA400H and PA500H are standard abrasion resistant steel plates, with hardness levels of 400 and 500HBW, respectively. The AR400F is a high-toughness abrasion resistant steel plate with a hardness of 400HBW, ensuring low-temperature impact toughness at -40°C, making it suitable for components in low-temperature environments.

EN10025-6 S690QL、S890QL
high yield strength structural steel plate

The high-yield strength structural steels S690QL and S890QL, produced using direct quenching and tempering process, achieve yield strengths of 690 and 890MPa, respectively. In addition, they possess excellent low-temperature toughness at -40°C, making them suitable for mechanical structures, offering enhanced load-bearing capacity and impact resistance.

CNS 15504 (JIS G3140) SBHS400
higher yield strength steel plate for bridge

SBHS400 is a bridge structural steel with a yield strength of 400MPa. This product not only has a yield strength that is 16% higher than A709 Gr.50, but also offers superior impact toughness and can be welded without preheating. This significantly enhances the efficiency of steel bridge welding and helps to shorten construction time.

ASTM A537 CL.2
Carbon-Manganese-Silicon pressure vessel steel plate

ASTM A537 CL.2 is a pressure vessel steel plate produced using direct quenching and tempering process, with a yield strength of 415MPa. It offers higher tensile and yield strengths compared to A537 CL.1 and is suitable for manufacturing boilers and pressure vessels in industries such as oil, chemicals, and natural gas.

EN10025-4 S355ML、S420ML、S460ML
weldable fine grain structural steel plate

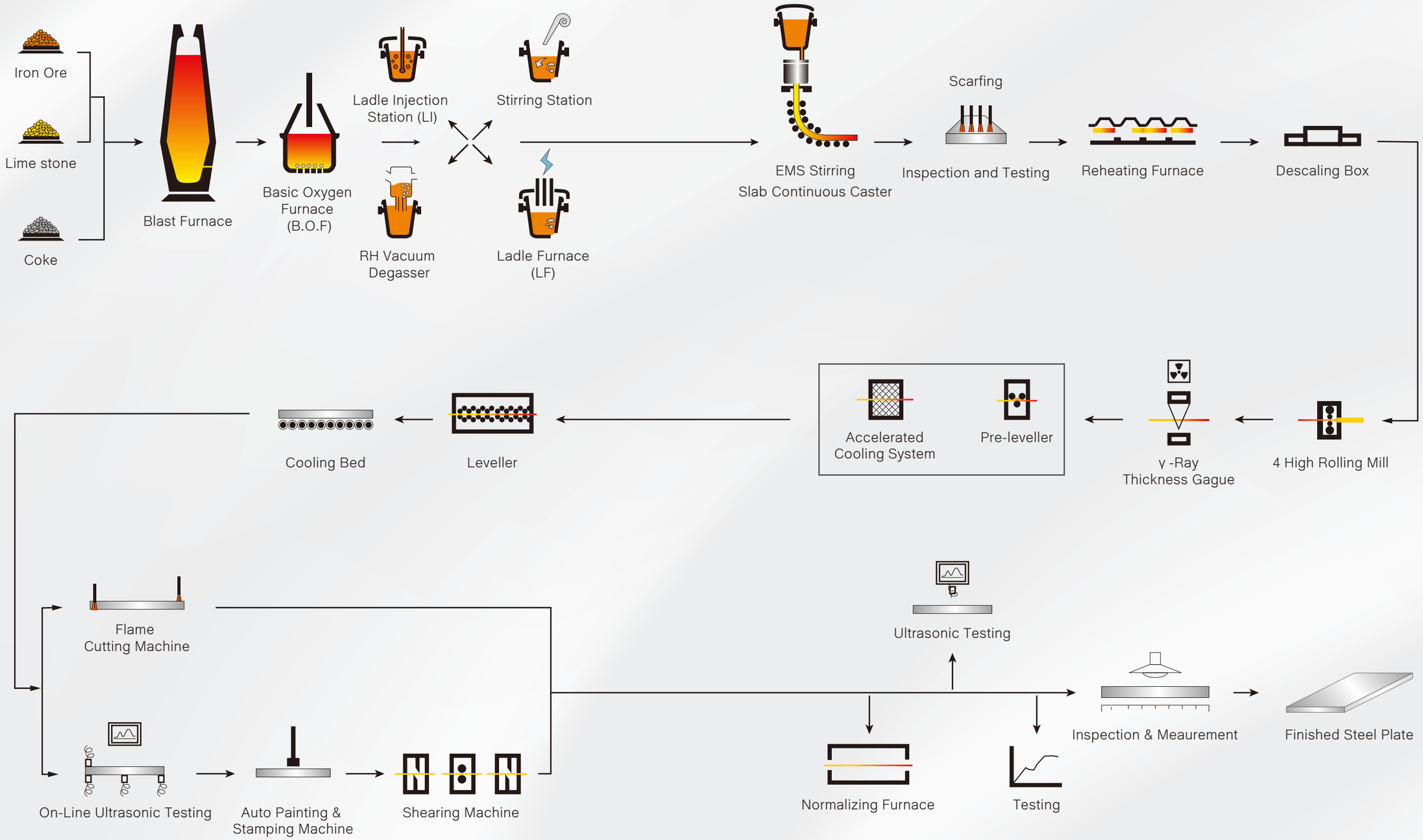
The high-yield strength structural steel plates S355ML, S420ML, and S460ML are designed with low phosphorus, low sulfur, and low carbon equivalent components. They are produced using the Thermo-mechanical Control Process (TMCP), achieving yield strengths of 355, 420, and 460MPa, respectively. These steels exhibit excellent weldability and low-temperature impact toughness at -50°C, making them suitable for use in wind turbine towers and mechanical structures.

ASTM A709 GR.HPS 70W
high-performance atmospheric corrosion resistance structural steel plate for bridge

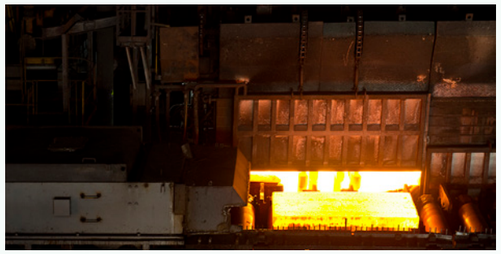
A709 Gr.HPS 70W is a weathering bridge structural steel plate with yield strength of 485MPa. It not only has a 40% higher strength compared to A709 Gr.50, but also offers superior weldability and impact toughness, allowing for lower preheating temperatures before welding. The plates with a thickness less than or equal to 40mm can even satisfy requirements for omission of preheating in general welding conditions, which enhances welding efficiency. Additionally, this product contains weathering resistant elements such as copper, chromium, and nickel, providing better atmospheric corrosion resistance than standard structural steels. This new product is suitable for bridge construction near coastal areas.

ASTM A514/S、A514/B、CSC PZ780T
higher strength rolled steel plate for welded structure

ASTM A514/S, A514/B, and CSC PZ780T are high-strength structural steel plates produced using direct quenching and tempering process, with tensile strength of 780MPa. These products can not only enhance the load-bearing capacity and durability of heavy machinery, but also reduce the weight of such machinery due to the thickness reduction benefit brought by their ultra-high strength.


Iron Ore
Lime stone
Coke
Blast Furnace
Basic Oxygen Furnace (B.O.F)
Ladle Injection Station (LI)
RH Vacuum Degasser
Stirring Station
Ladle Furnace (LF)
EMS Stirring Slab Continuous Caster
Scarfing
Inspection and Testing
Reheating Furnace
Descaling Box
4 High Rolling Mill
γ -Ray Thickness Gague
Accelerated Cooling System
Pre-leveller
Leveller
Cooling Bed
Flame Cutting Machine
On-Line Ultrasonic Testing
Auto Painting & Stamping Machine
Shearing Machine
Ultrasonic Testing
Normalizing Furnace
Testing
Inspection & Meaurement
Finished Steel Plate

Major Equipments In CSC Plate Mill



Reheating Furnace

Slabs are heated a temperature in a typical range of 1150 to 1270°C. Reheating reduces the deformation strength of slabs sufficiently to allow it to be rolled, and ensure that all alloy elements are in solid solution.

4 High Rolling Mill (4Hi)

The rolling process for a plate thus has to achieve the correct dimensions. The device (HAGC, WRB, AWC) is used to obtain excellent dimensional accuracy and uniformity.

Vertical Edge

The addition of an edger and its integrated width control automation package gives more accurate control of the product width and significantly reduces width variations.

Direct Quenching (DQ)

The 8-meter-long equipment is located between the 4 high rolling mill and the ACC. It uses high-pressure jet water to quickly take away heat, achieve higher cooling rate, and obtain high-strength phase-transformed structures.

Accelerated Cooling (CSAC)

ACC equipments can be used to realize TMCP process and improve the properties of steel plates. Thermo-mechanical control process (TMCP) is a micro-structural control technique combining controlled rolling and cooling.

Hot Leveler

Leveler is a stress relief process carried out through low and controlled elongation in a multi-roller machine, the plate surface undergoing a series of reverse bends.

Cooling Bed

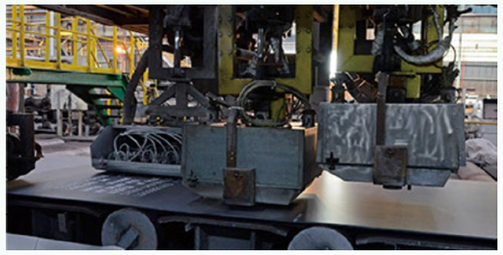
Plates are finally air cooled as they are transferred across a cooling bed. In special cases, stacking of plates to reduce the cooling rate is employed.

Ultrasonic Testing

Ultrasonic Testing is a form of quality assurance used for ensuring the strength and quality of rolled steel plate.

Automated Surface Inspection System (ASIS)

The all-steel plate surface automatic image inspection system improves defect detection capabilities and provides immediate feedback on the steel plate surface quality to ensure compliance with order requirements.



Hot Painting

Paint printing can be done on the surface of steel plate according to the requirements of customers and standards.

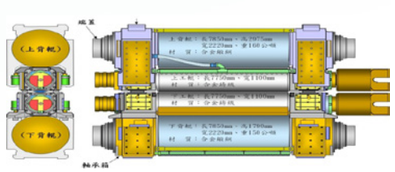
Shearing device

As well as cutting discrete plates to their ordered sizes. The shear-line also extracts test samples which are used to certify the plate properties.

Normalizing furnace

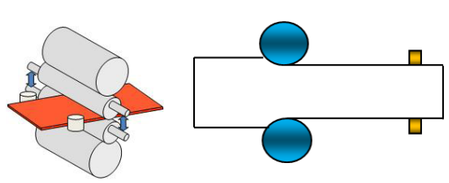
The plates be treated by roller normalizing furnace, which can normalize, temper, annealing and stress-relieving.

Introduction to Processes and Technologies of Steel Plate



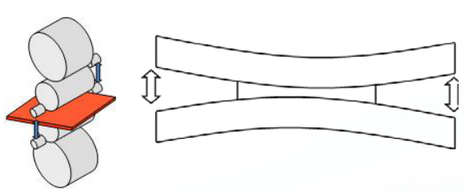
AGC
(Hydraulic Automatic Gauge Control)

Automatic gauge control (AGC) is a closed loop control function designed to regulate thickness at the exit of the rolling mill stand to increase the thickness accuracy. To make sure that the flat products rolled in the mill are of required uniform thickness within the required tolerance.



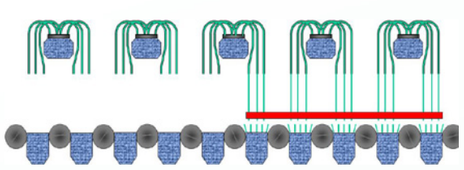
AWC
(Automatic Width Control)

Automatic width control (AWC) can be applied at each edger to provide in-bar width control to increase the width accuracy by adjusting the roll gap. The addition of an edger and its integrated width control automation package gives more accurate control of the product width and significantly reduces with variations.



WRB
(Work Roll Bending System)

The crowned roller will only compensate for one set of condition, specifically the material, temperature and amount of deformation. Work roll bending involves using hydraulic cylinders at the ends of the rolls to counteract roll deflection. To make sure the flatness coming into the mill will be preserved at the exit of the mill.



EACC
(Extended Accelerated Cooling)

Installed after the 4Hi mill, combined with 8m DQ and 24m CSAC equipments, utilizing dense high-pressure cooling water, Edge Masking, Water Crown, and head-tail shielding control to enhance the width and edge cooling uniformity of the steel plates, resulting in the microstructure with different strength.

5.1 Building Structure

China Steel Building was constructed by building structure steel

SN490B、SN490C

Taipei 101 Building was constructed by using steel

CSC SM570M

for welded structures.

5.2 Welded Structure

National Stadium of Kaoshiung is constructed by CSC's building structure steel SN490A and high strength structural steel A572 Gr.50.

China Steel auditorium was constructed by atmospheric corrosion resistant structural steel A588.

5.3 Hull Construction

The 14,000 TEU cargo ship of Yang-Ming Marine Transport Corporation (Taiwan) was constructed by CSC's EH47 ship plates.

5.4 Pressure Vessel

Tank truck was made of pressure vessel steel.

5.5 Bridge Structure

Xinfa bridge, which was donated and constructed by CSC Group, was built by atmospheric corrosion structural steel A709 Gr.50W.

Danjiang Bridge located in Tamsui, Taipei was built by high performance atmospheric corrosion resistance structural steel A709 Gr.HPS 70W.

5.6 Specialty Usage

One of CSC plant site chimneys was made from corrosion resistant steel SCR-TEN.

Unloading grab at CSC Group terminal was made from CSC's abrasion resistant steel plates.

6.1 Chemical Compositions and Mechanical Properties

Chemical Compositions

The guaranteed chemical compositions are in accordance with international standards and are based on molten steel analysis. It shall be noted that there may be permissible deviations between molten steel analysis and product analysis. The permissible deviation range is determined by the relevant international standards, such as JIS G0321, SAE J409, and ASTM A6.

6.1.1 Steel Plates for General Structural Usage

6.1.1.1 CNS 2473-14、JIS G3101-24 Rolled Steels for General Structure

Grade	Chemical Compositions %				Mechanical Properties							
					Tension Test							
					Yield Point or Yield Strength (N/mm²)				Tensile Strength (N/mm²)	Elongation		
					Thickness (t) mm							
	C	Mn	P	S	t ≦ 16	16 < t ≦ 40	40 < t ≦ 100	t > 100		Thickness (t) mm	Test Piece	%
SS330	—	—	0.050 max.	0.050 max.	205 min.	195 min.	175 min.	165 min.	330 ~430	6 ≦ t ≦ 16	No.1A	21 min.
										16 < t ≦ 50	No.1A	26 min.
										40 < t	No.4	28 min.
SS400					245 min.	235 min.	215 min.	205 min.	400 ~510	6 ≦ t ≦ 16	No.1A	17 min.
										16 < t ≦ 50	No.1A	21 min.
										40 < t	No.4	23 min.
SS490					285 min.	275 min.	255 min.	245 min.	490 ~610	6 ≦ t ≦ 16	No.1A	15 min.
										16 < t ≦ 50	No.1A	19 min.
										40 < t	No.4	21 min.
SS540	0.30 max.	1.60 max.	0.040 max.	0.040 max.	400 min.	390 min.	—	—	540 min.	6 ≦ t ≦ 16	No.1A	13 min.
										16 < t ≦ 40	No.1A	17 min.

Remark：1. Alloy elements other than those shown in the above table may be added necessary. For CNS 2473, Borbon content shall be less than 0.0008%.

2. For the elongation of No.4 test piece for steel plates over 90mm in thickness, it shall be subtracted 1% from the values of elongation per each increase of 25.0mm or its fraction in thickness. However, the limit to be subtracted shall be 3%.

3. Applicable thickness range: SS330 is from 6 to 50mm, SS400 is from 6 to 150mm, SS490 is from 6 to 50mm and SS540 is from 6 to 40mm.

6.1.1.2 CNS 2947-23、JIS G3106-24 Rolled Steels for Welded Structure

Grade	Thickness (t) mm	Chemical Compositions %				
		C	Si	Mn	P	S
SM400A	t ≦ 50	0.23 max.	–	2.5 × C max.	0.035 max.	0.035 max.
	50 < t ≦ 90	0.25 max.				
SM400B	t ≦ 50	0.20 max.	0.35 max.	0.60~1.40		
	50 < t ≦ 90	0.22 max.				
SM400C	t ≦ 90	0.18 max.	0.35 max.	1.40 max.		
SM490A	t ≦ 50	0.20 max.	0.55 max.	1.65 max.	0.035 max.	0.035 max.
	50 < t ≦ 90	0.22 max.				
SM490B	t ≦ 50	0.18 max.	0.55 max.	1.65 max.		
	50 < t ≦ 90	0.20 max.				
SM490C	t ≦ 100	0.18 max.	0.55 max.	1.65 max.		
SM490YA	t ≦ 90	0.20 max.	0.55 max.	1.65 max.	0.035 max.	0.035 max.
SM490YB						
SM520B	t ≦ 90	0.20 max.	0.55 max.	1.65 max.	0.035 max.	0.035 max.
SM520C						
SM570	t ≦ 90	0.18 max.	0.55 max.	1.70 max.	0.035 max.	0.035 max.

Remark：Alloy elements other than those shown in the above table may be added necessary. For CNS 2947, Borbon content shall be less than 0.0008%.

Grade	Mechanical Properties											
	Tension Test									Impact Test		
	Yield Point or Yield Strength (N/mm²)					Tensile Strength (N/mm²)	Elongation			Test Temp ℃	Charpy Absorbed Energy Average(J)	Test Piece
	Thickness (t) mm						Thickness (t) mm	Test Piece	%			
	t ≦ 16	16 < t ≦ 40	40 < t ≦ 75	75 < t ≦ 100	100 < t ≦ 160							
SM400A	245 min.	235 min.	215 min.	215 min.	205 min.	400~510	6 ≦ t ≦ 16	No.1A	18 min.	—	—	V-notch, Parallel to rolling direction
SM400B							16 < t ≦ 50	No.1A	22 min.	0	27 min.	
SM400C					—		40 < t	No.4	24 min.	0	47 min.	
SM490A	325 min.	315 min.	295 min.	295 min.	285 min.	490~610	6 ≦ t ≦ 16	No.1A	17 min.	—	—	
SM490B							16 < t ≦ 50	No.1A	21 min.	0	27 min.	
SM490C					—		40 < t	No.4	23 min.	0	47 min.	
SM490YA	365 min.	355 min.	335 min.	325 min.	—	490~610	6 ≦ t ≦ 16	No.1A	15 min.	—	—	
SM490YB							16 < t ≦ 50	No.1A	19 min.	0	27 min.	
							40 < t	No.4	21 min.			
SM520B	365 min.	355 min.	335 min.	325 min.	—	520~640	6 ≦ t ≦ 16	No.1A	15 min.	0	27 min.	
SM520C							16 < t ≦ 50	No.1A	19 min.	0	47 min.	
							40 < t	No.4	21 min.			
SM570	460 min.	450 min.	430 min.	420 min.	—	570~720	6 ≦ t ≦ 16	No.5	19 min.	-5	47 min.	
							16 < t	No5	26 min.			
							20 < t	No.4	20 min.			

Remark：Impact test is applicable to thickness over 12.0mm of steel.

6.1.1.3 CNS 13812-14、JIS G3136-22 Rolled Steels for Building Structure

Grade	Thickness (t) mm	Chemical Compositions%					
		C	Si	Mn	P	S	Ceq
SN400A	6.00 ≦ t ≦ 100.0	0.24 max.	—	—	0.050 max.	0.050 max.	—
SN400B	6.00 ≦ t ≦ 50.00	0.20 max.	0.35 max.	0.60~1.50	0.030 max.	0.015 max.	0.36 max.
	50.01 ≦ t ≦ 100.0	0.22 max.					
SN400C	16.00 ≦ t ≦ 50.00	0.20 max.			0.020 max.	0.008 max.	
	50.01 ≦ t ≦ 100.0	0.22 max.					
SN490B	6.00 ≦ t ≦ 40.00	0.18 max.	0.55 max.	1.65 max.	0.030 max.	0.015 max.	0.44 max.
	40.01 ≦ t ≦ 50.00						0.46 max.
	50.01 ≦ t ≦ 100.0	0.20 max.					
SN490C	16.00 ≦ t ≦ 40.00	0.18 max.			0.020 max.	0.008 max.	0.44 max.
	40.00 < t ≦ 50.00						0.46 max.
	50.01 ≦ t ≦ 100.0	0.20 max.					

Remark：1. Alloy elements other than those shown in the above table may be added necessary. For CNS 13812, Borbon content shall be less than 0.0008%.

2. Ceq＝C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14.

Grade	Mechanical Properties															U.T Inspection
	Tension Test												Impact Test			
	Yield Point or Yield Strength (N/mm²)				Tensile Strength (N/m²)	Yield Ratio%				Elongation%			Through-thickness characteristics %	Test Temp℃	Charpy Absorbed Energy Average (J)	Test Piece	
										No.1A		No.4					
	Thickness(t) mm					Thickness(t) mm				Thickness(t) mm							
	t < 12	12 ≦ t < 16	16 ≦ t ≦ 40	40 < t ≦ 100		t <12	12 ≦ t < 16	16 ≦ t ≦ 40	40 < t ≦ 100	t ≦ 16	16 < t ≦ 50	40 < t ≦ 100	Average/ Individual				
SN400A	235 min.	235 min.	235 min.	215 min.	400~510	—	—	—	—	17 min.	21 min.	23 min.	—	—	—	—	—
SN400B	235 min.	235~355	235~355	215~335		—	80 max.	80 max.	80 max.	18 min.	22 min.	24 min.	—	0	27 min.	V-notch, Parallel to rolling direction	Note 2.(1)
SN400C	—	—					—						25/15 min.				Note 2.(2)
SN490B	325 min.	325~445	325~445	295~415	490~610		80 max.			17 min.	21 min.	23 min.	—				Note 2.(1)
SN490C	—	—					—						25/15 min.				Note 2.(2)

Remark：1. Impact test is applicable to thickness over 12.0mm of steel.

2. Ultrasonic Test:

(1) If agreement between the purchaser and the supplier, SN400B and SN490B may be tested in accordance with CNS 12845/JIS G0901 CL.Y. (t ≧ 13.00mm)

(2) SN400C and SN490C shall be tested in accordance with CNS 12845/JIS G0901 CL.Y. (t ≧ 16.00mm)

6.1.1.4 CNS13812-14 SN490YB 及 SN490YC (Rolled Steels for Building Structure)

Grade	Thickness (t) mm	Chemical Compositions%					
		C	Si	Mn	P	S	Ceq
SN490YB	6 ≦ t ≦ 40	0.18 max.	0.55 max.	1.60 max.	0.030 max.	0.015 max.	0.44 max.
	40 < t ≦ 80						0.46 max.
SN490YC	16 ≦ t ≦ 40	0.18 max.	0.55 max.	1.60 max.	0.020 max.	0.008 max.	0.44 max.
	40 < t ≦ 80						0.46 max.

Remark：1. Alloy elements other than those shown in the above table may be added necessary. For CNS 13812, Borbon content shall be less than 0.0008%.

2. Ceq = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14.

Grade	Mechanical Properties									
	Yield Point or Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Yield Ratio %	Elongation			Through-thickness characteristics	Impact Test		
				Thickness (t) mm	Test Piece	%	Average/ Individual (%)	Test Temp	Charpy Absorbed Energy Average	Test Piece
SN490YB	325~445	490~610	80 max.	6 ≦ t ≦ 16	No.1A	17 min.	-	0℃	27J min.	V-notch, Parallel to rolling direction
				16 < t ≦ 50	No.1A	21 min.				
				50 < t ≦ 80	No.4	23 min.				
SN490YC	325~445	490~610	80 max.	t = 16	No.1A	17 min.	25/15 min.			
				16 < t ≦ 50	No.1A	21 min.				
				50 < t ≦ 80	No.4	23 min.				

Remark：Impact test is applicable to thickness over 12.0mm of steel.

6.1.1.5 CNS 15504-24、JIS G3140-23 SBHS500 (Higher Yield Strength Steel Plates for Bridges)

Thickness (t) mm	Chemical Compositions%							Mechanical Properties							
	C	Si	Mn	P	S	N	Pcm	Yield Point or Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation			Impact Test		
										No.5	No.5	No.4	Test Temp	Charpy Absorbed Energy Average	Test Piece
										Thickness(t) mm					
										13 ≦ t ≦ 16	16 < t ≦ 20	20 < t ≦ 80			
15 ≦ t ≦ 80	0.11 max.	0.55 max.	2.00 max.	0.020 max.	0.006 max.	0.006 max.	0.20 max.	500 min.	570 ~720	19 min.	26 min.	20 min.	-5℃	100J min.	V-notch, perpendicular to rolling direction

Remark：Pcm(%) = C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B.

6.1.1.6 ASTM A36-19 Carbon Structural Steel

Thickness (t) mm	Chemical Compositions%					Mechanical Properties			
						Tension Test			
	C	Si	Mn	P	S	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Elongation	
								Test Piece in.(mm)	%
t ≦ 19.05	0.25 max.	0.40 max.	—	0.030 max.	0.030 max.	36 (250) min.	58~80 (400~550)	GL=8(200) GL=2(50)	20 min. 23 min.
19.05 < t ≦ 38.10	0.25 max.		0.80 ~1.20						
38.10 < t ≦ 63.50	0.26 max.	0.15 ~0.40							
63.50 < t ≦ 101.6	0.27 max.		0.85 ~1.20						
101.6 < t	0.29 max.								

Remark：1. When copper steel is specified, minimum Cu shall be 0.20%.
2. 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%.
3. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.
4. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A6 for elongation adjustment.

6.1.1.7 ASTM A283-18 Low and Intermediate Tensile Strength Carbon Steel Plates

Grade	Chemical Compositions%						Mechanical Properties			
							Tension Test			
	C	Si		Mn	P	S	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Elongation	
		Thickness (t) mm							Test Piece in.(mm)	%
		t ≦ 38.1	t > 38.1							
Grade C	0.24 max.	0.40 max.	0.15 ~0.40	0.90 max.	0.030 max.	0.030 max.	30 (205) min.	55~75 (380~515)	GL=8(200) GL=2(50)	22 min. 25 min.
Grade D	0.27 max.						33 (230) min.	60~80 (415~550)	GL=8(200) GL=2(50)	20 min. 23 min.

Remark：1. When copper steel is specified, minimum Cu shall be 0.20%.
2. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.
3. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A6 for elongation adjustment.
4. Applicable thickness range of this specification is from 6.00 to 50.80mm.

6.1.1.8 ASTM A572-21 High-Strength Low-Alloy Columbium-Vanadium Structural Steel

Grade	Thickness (t) mm	Chemical Compositions%[1]						Mechanical Properties			
								Tension Test			
		C	Si	Mn[2]	P	S	Alloy Content[7]	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Test Piece in.(mm)	%[5] [6]
Grade 42	t ≦ 38.10	0.21 max.	0.40 max.	1.35[3] max.	0.030 max.	0.030 max.	Type 1 [Nb]：0.005~0.050 Type 2 [V]：0.010~0.150 Type 3 [Nb]：0.005~0.050 [V]：0.010~0.150 [Nb]+[V]：0.02~0.15	42(290) min.	60(415) min.	GL=8(200) GL=2(50)	20 min. 24 min.
	38.10 < t ≦ 101.6		0.15 ~0.40								
Grade 50	t ≦ 38.10	0.23 max.	0.40 max.					50(345) min.	65(450) min.	GL=8(200) GL=2(50)	18 min. 21 min.
	38.10 < t ≦ 101.6		0.15 ~0.40								
Grade 55	t ≦ 38.10	0.25 max.	0.40 max.					55(380) min.	70(485) min.	GL=8(200) GL=2(50)	17 min. 20 min.
	38.10 < t ≦ 63.50		0.15 ~0.40								
Grade 60	t ≦ 38.10	0.26 max.	0.40 max.					60(415) min.	75(520) min.	GL=8(200) GL=2(50)	16 min. 18 min.
	38.10 < t ≦ 63.50		0.15 ~0.40								
Grade 65	t ≦ 12.70[4]	0.26 max.	0.40 max.					65(450) min.	80(550) min.	GL=8(200) GL=2(50)	15 min. 17 min.
	12.70 < t ≦ 38.10	0.23 max.		1.65 max.							
	38.10 < t ≦ 50.80		0.15 ~0.40								

Remark：1. When copper steel is specified, minimum Cu shall be 0.20%.

2. Manganese, minimum by heat analysis of 0.80% shall be required for all plates over 3/8 in.(9.53mm) in thickness, a minimum of 0.50% shall be required for plates 3/8 in.(9.53mm) and less in thickness, and for all other products. The manganese to carbon ratio shall not be less than 2 to 1.
3. Grades 42, 50, 55, 60 and Grade 65(t ≦ 12.70mm): For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.60%.
4. Grade 65(t ≦ 12.70mm): An alternative chemical requirement with a maximum carbon of 0.21% and a maximum manganese of 1.65% is permited.
5. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2% for Grades 42, 50 and 55, and 3% for Grades 60 and 65.
6. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A6 for elongation adjustment.
7. Unless specified by the purchaser, the selection of Type (1, 2, 3 or 5) is at the option of the producer.

6.1.1.9 ASTM A573-20 Structural Carbon Steel Plates

<table>
<tr><th rowspan="4">Grade</th><th rowspan="4">Thickness (t)mm</th><th colspan="5">Chemical Compositions%</th><th colspan="4">Mechanical Properties</th></tr>
<tr><th rowspan="3">C</th><th rowspan="3">Si</th><th rowspan="3">Mn</th><th rowspan="3">P</th><th rowspan="3">S</th><th colspan="4">Tension Test</th></tr>
<tr><th rowspan="2">Yield Point ksi (N/mm²)</th><th rowspan="2">Tensile Strength ksi (N/mm²)</th><th colspan="2">Elongation</th></tr>
<tr><th>Test Piece in.(mm)</th><th>%</th></tr>
<tr><td>Grade 58</td><td>t ≦ 38.10</td><td>0.23 max.</td><td>0.10 ~0.35</td><td>0.60 ~0.90</td><td rowspan="5">0.030 max.</td><td rowspan="5">0.030 max.</td><td>32 (220) min.</td><td>58~71 (400~490)</td><td>GL=8(200) GL=2(50)</td><td>21 min. 24 min.</td></tr>
<tr><td rowspan="2">Grade 65</td><td>t ≦ 12.70</td><td>0.24 max.</td><td rowspan="4">0.15 ~0.40</td><td rowspan="4">0.85 ~1.20</td><td rowspan="2">35 (240) min.</td><td rowspan="2">65~77 (450~530)</td><td rowspan="2">GL=8(200) GL=2(50)</td><td rowspan="2">20 min. 23 min.</td></tr>
<tr><td>12.70 < t ≦ 38.10</td><td>0.26 max.</td></tr>
<tr><td rowspan="2">Grade 70</td><td>t ≦ 12.70</td><td>0.27 max.</td><td rowspan="2">42 (290) min.</td><td rowspan="2">70~90 (485~620)</td><td rowspan="2">GL=8(200) GL=2(50)</td><td rowspan="2">18 min. 21 min.</td></tr>
<tr><td>12.70 < t ≦ 38.10</td><td>0.28 max.</td></tr>
</table>

Remark : 1. Grades 58 and 65: For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.50%.

2. Grade 70: For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.60%.

3. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.

4. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A6 for elongation adjustment.

6.1.1.10 ASTM A709-21 Structural Steel for Bridges

Grade	Thickness (t)mm	Chemical Compositions%						Mechanical Properties[7]			
								Tension Test			
		C	Si	Mn	P	S	Alloy Comtent	Yield Point or Yield Strength ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Elongation[5][6]	
										Test Piece in.(mm)	%
Grade 36[1][2]	t ≦ 19.05	0.25 max.	0.40 max.	–	0.030 max.	0.030 max.	–	36(250) min.	58~80 (400~550)	GL=8(200) GL=2(50)	20 min. 23 min.
	19.05 < t ≦ 38.10	0.25 max.		0.80 ~1.20							
	38.10 < t ≦ 63.50	0.26 max.	0.15 ~0.40	0.80 ~1.20							
	63.50 < t ≦ 101.6	0.27 max.		0.85 ~1.20							
Grade 50[1][3]	t ≦ 38.10	0.23 max.	0.40 max.	1.35 max.	0.030 max.	0.030 max.	Type 1 [Nb]：0.005~0.050 Type 2 [V]：0.010~0.150 Type 3 [Nb]：0.005~0.050 [V]：0.010~0.150 [Nb]+[V]：0.02~0.15	50(345) min.	65(450) min.	GL=8(200) GL=2(50)	18 min. 21 min.
	38.10 < t ≦ 101.6	0.23 max.	0.15 ~0.40								
Grade 50W Type A[4]	t ≦ 101.6	0.19 max.	0.30 ~0.65	0.80 ~1.25	0.030 max.	0.030 max.	Ni: 0.40 max. / Cr: 0.40 ~0.65 / Cu: 0.25 ~0.40 / V: 0.02 ~0.10	50(345) min.	70(485) min.	GL=8(200) GL=2(50)	18 min. 21 min.

Remark：1. When copper is specified, minimum Cu shall be 0.20%.

2. Grade 36: 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 a maximum of 1.35%

3. Grade 50: manganese, minimum by heat analysis of 0.80% shall be required for all plates over 3/8 in.(9.53mm) in thickness, a minimum of 0.50% shall be required for plates 3/8 in.(9.53mm) and less in thickness. For all products, the manganese to carbon ratio shall not be less than 2 to 1. For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.60%.

4. Grade 50W Type A: For each reduction of 0.01% below the specified maximum for carbon, an increase of 0.06% above the specified maximum for manganese is permitted, up to a maximum of 1.50%.

5. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.

6. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A6 for elongation adjustment.

7. Supplementary requirements: (Supplementary requirements shall not apply unless specified in the purchase order or contact)

Structural products ordered for use as critical member shall be impact tested in accordance with ASTM A673. Guidance is as follows:

(1) Fracture critical member shall specify Grades 36F, 50F or 50WF, the CNV-impact testing shall be at P frequency in accordance with ASTM A673.

(2) Non-fracture critical member shall specify Grades 36T, 50T or 50WT, the CNV-impact testing shall be at H frequency in accordance with ASTM A673.

(3) Test temperature for Zone1, Zone2 and Zone3 are respectively +70˚F(+21℃), +40˚F(+04℃) and +10˚F(-12℃). Depending on the environment where the bridge is located, purchaser have different choices.

Grade		Thickness (t) mm	Impact Test				
			Test Temp			Charpy Absorbed Energy ft · lbf (J)	
			Zone 1	Zone 2	Zone 3	Average	Individual
Grade 36	T	t ≦ 101.6	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	15 (20) min.	10 (14) min.
	F	t ≦ 101.6	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	25 (34) min.	20 (27) min.
Grade 50 Grade 50W	T	t ≦ 50.80	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	15 (20) min.	10 (14) min.
		50.81 < t ≦ 101.6	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	20 (27) min.	14 (18) min.
	F	t ≦ 50.80	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	25 (34) min.	20 (27) min.
		50.81 < t ≦ 101.6	+70˚F (+21℃)	+40˚F (+04℃)	+10˚F (-12℃)	30 (41) min.	24 (33) min.

Note：Test piece is V-notch, and direction parallel to rolling direction. Using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.

6.1.1.11 EN10025-2 (2019) Hot rolled products of non-alloy structural steels

Grade	Chemical Compositions%													
	C (max)			Mn (max)	P (max)	S (max)	Si (max)	Cr (max)	Ni[2] (max)	Mo (max)	Cu (max)	N (max)	Ceq[3]		
	16.00 mm max.	16.01-40.00 mm	over 40.00 mm										30.00 mm max.	30.01-40.00 mm	40.01-150.0 mm
S235JR	0.17	0.17	0.20	1.40	0.035	0.035	-	0.29	0.42	0.11	0.55	0.012	0.35 max.	0.35 max.	0.38 max.
S235J0	0.17	0.17	0.17	1.40	0.030	0.030	-	0.29	0.42	0.11	0.55	0.012			
S235J2	0.17	0.17	0.17	1.40	0.025	0.025	-	0.29	0.42	0.11	0.55	-			
S275JR	0.21	0.21	0.22	1.50	0.035	0.035	-	0.29	0.42	0.11	0.55	0.012	0.40 max.	0.40 max.	0.42 max.
S275J0	0.18	0.18	0.18	1.50	0.030	0.030	-	0.29	0.42	0.11	0.55	0.012			
S275J2	0.18	0.18	0.18	1.50	0.025	0.025	-	0.29	0.42	0.11	0.55	-			
S355JR	0.24	0.24	0.24	1.60	0.035	0.035	0.55	0.29	0.42	0.11	0.55	0.012	0.45 max.	0.47 max.	0.47 max.
S355J0	0.20	0.20[1]	0.22	1.60	0.030	0.030	0.55	0.29	0.42	0.11	0.55	0.012			
S355J2	0.20		0.22	1.60	0.025	0.025	0.55	0.29	0.42	0.11	0.55	-			

Remark：1. For nominal thickness > 30mm : C = 0.22% max.

2. The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0.020% or altermatively min. 0.015% acid soluble Al.

3. Ceq(%) = C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

Grade	Tension Test[1]												Impact Test[3]	
	Yield Strength (N/mm²)						Tensile Strength (N/mm²)		Elongation (min.) (L_0=5.65S_0)				Test Temp ℃	Charpy Absorbed Energy Average[4] (J)
	16.00 mm max.	16.01-40.00 mm	40.01-63.00 mm	63.01-80.00 mm	80.01-100.0 mm	100.1-150.0 mm	6.00-100.0 mm	100.1-150.0 mm	Orientaion of Test Piece[2]	6.00-40.00 mm	40.01-63.00 mm	63.01-100.0 mm	100.1-150.0 mm	
S235JR	235 min.	225 min.	215 min.	215 min.	215 min.	195 min.	360 ~510	350 ~500	Trans. Long.	24% 26%	23% 25%	22% 24%	22% 22%	20[5]
S235J0														0
S235J2														-20
S275JR	275 min.	265 min.	255 min.	245 min.	235 min.	225 min.	410 ~560	400 ~540	Trans. Long.	21% 23%	20% 22%	19% 21%	19% 19%	20[5]
S275J0														0
S275J2														-20
S355JR	355 min.	345 min.	335 min.	325 min.	315 min.	295 min.	470 ~630	450 ~600	Trans. Long.	20% 22%	19% 21%	18% 20%	18% 18%	20[5]
S355J0														0
S355J2														-20

Remark：1. For plate, strip and wide flats with widths ≥ 600 mm, the direction transverse to the rolling direction applies. For all other products, the values apply for the direction parallel to the rolling direction.

2. Trans.: transverse to the rolling direction；Long.: parallel to the rolling direction.

3. Test piece is V-notch, and direction parallel to rolling direction.

4. Using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.

5. The impact properties of quality JR products are verified only when specified at the time of the order.

6.1.1.12 CSC LYS100 (Low Yielding Strength Steel Plates)

Thickness (t) mm	Tension Test			
	Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation	
			Test Piece	%
6.00 ≦ t < 20.00	70~120	200~300	JIS No.5	50.0 min.
20.00 ≦ t ≦ 50.80			JIS No.4	

6.1.1.13 CSC PZ590T (Rolled Steels for Welded Structure, Tenslie strength 590N/mm² min.)

Thickness (t) mm	Chemical Compositions%						Tension Test				Through-thickness characteristics		Impact Test		
	C	Si	Mn	P	S	Ceq[1]	Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation%		AVG	IDV	Test Temp	Absorbed Energy Average	Test Piece
									No.5[2]	No.4[2]					
15.00 ≦ t ≦ 20.00	0.09 max.	0.55 max.	1.80 max.	0.020 max.	0.008 max.	0.44 max.	440 min.	590 ~740	20 min.	20 min.	-	-	-5℃	47J min.	Parallel to rolling direction
20.00 < t ≦ 40.00						0.44 max.					25 min.	15 min.			
40.00 < t ≦ 80.00						0.47 max.					25 min.	15 min.			

Remark : 1. Ceq (%) = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14.

2. Test piece No.5 is applicable to steel with thickness between 15.00 to 20.00mm. Test piece No.4 is applicable to steel with thickness over 20.01mm.

6.1.1.14 CSC SM570M (Building Structure with excellent strength and weldability)

Grade	Thickness (t) mm	Chemical Compositions%					
		C	Si	Mn	P	S	Ceq[2]
SM570M-A	13.00~49.99	0.18 max.	0.55 max.	1.60 max.	0.030 max.	0.008 max.	0.44 max.
SM570M-B	13.00~49.99						0.44 max.
	50.00~60.00						0.46 max.
SM570M-C	16.00~49.99	0.18 max.	0.55 max.	1.60 max.	0.020 max.	0.008 max.	0.44 max.
	50.00~80.00						0.46 max.
SM570M-C HW[1]	16.00~49.99						0.44 max.
	50.00~80.00						0.46 max.

Remark : 1. CSC SM570M-C HW is fit to high heat input welding. The heat affected zone (HAZ) is permitted by 880 KJ/cm in input welding. The impact test (-5℃) in fusion line shall be achieved above 15 Joules in guarantee.

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

Grade	Thickness (t) mm	Tension Test					Through-thickness characteristics %	
		Yield Point or Yield Strength[1] (N/mm^2)	Tensile Strength (N/mm^2)	Yield Ratio (Y/T) (%)	Elongation (%)	Test Piece	Average (min.)	Individual (min.)
SM570M-A	13.00~16.00	420~540	570~720	85 max.	19 min.	No.5	—	—
	16.01~20.00				26 min.	No.5		
	20.01~49.99				20 min.	No.4		
SM570M-B	13.00~16.00	420~540	570~720	85 max.	19 min.	No.5	—	—
	16.01~20.00				26 min.	No.5		
	20.01~40.00				20 min.	No.4		
	40.01~49.99	420~540	570~720	80 max.	20 min.	No.4	—	—
	50.00~60.00						25	15
SM570M-C	16.00	420~540	570~720	85 max.	19 min.	No.5	25	15
	16.01~20.00				26 min.	No.5		
	20.01~80.00				20 min.	No.4		
SM570M-C HW	16.00	420~540	570~720	85 max.	19 min.	No.5	25	15
	16.01~20.00				26 min.	No.5		
	20.01~80.00				20 min.	No.4		

Remark：1.The lower yield strength shall be determined. If a yield phenomenon is not present, then 0.2% proof strength shall be determined.

Grade	Thickness (t) mm	Impact Test				U.T Inspection
		Position	Test Temp	Charpy Absorbed Energy Average	Test Piece	
SM570M-A	13.00~49.99	t/4	-5℃	47J min.	Parallel to rolling direction	In accordance with JIS G0901
SM570M-B	13.00~49.99	t/4	-5℃	47J min.		
	50.00~60.00	t/4 t/2	-5℃ -5℃	47J min. 27J min.		
SM570M-C	16.00~49.99	t/4	-5℃	47J min.		
	50.00~80.00	t/4 t/2	-5℃ -5℃	47J min. 27J min.		
SM570M-C HW	16.00~49.99	t/4	-5℃	47J min.		
	50.00~80.00	t/4 t/2	-5℃ -5℃	47J min. 27J min.		

6.1.2 Shipbuilding Steel Plates

6.1.2.1 CR(2023) Ordinary-Strength Hull Structural Steel

Grade	Chemical Compositions%							Mechanical Properties					
								Tension Test			Impact Test		
	C	Si	Mn	P	S	Al (acid soluble)	C+ Mn/6	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)	Elongation (%) Test Piece GL= 5.65 √ A	Test Temp ˚C	Charpy Absorbed Energy Average[4] Long. (Trans.)[6] Thickness(t) mm	
												t ≦ 50.0	50.0 < t ≦ 70.0
Grade A	0.21 max.	0.50 max.	2.5 × C min.	0.035 max.	0.035 max.	–	0.40 max.	235 min.	400 ~520	22[5] min.	+20	–	34J[8] (24J)[8]
Grade B	0.21 max.	0.35 max.	0.80[1] min.			–	0.40 max.				0	27J[7] (20J)[7]	34J (24J)
Grade D	0.21 max.	0.35 max.	0.60 min.			0.015[2][3] min.	0.40 max.				-20	27J (20J)	
Grade E	0.18 max.	0.35 max.	0.70 min.			0.015[3] min.	0.40 max.				-40		

Remark：1. When Grade B steel is impact tested, the minimum Manganese content may be reduced to 0.60%.

2. Content of Aluminium is not required for Grade D steel up to 25mm in thickness.

3. For Grade D over 25mm and Grade E steels, the total Aluminium content may be determined instead of acid soluble content. In such cases, the total Aluminium content is to be not less than 0.020%.

4. When using test pieces of width less than 10mm, the minimum values shall be corrected as the following table.

Width of Test Specimen W (mm)	Charpy Absorbed Energy (min.)
10.0	E
7.5	5/6*E
5.0	2/3*E

5. For full thickness flat tensile test specimens with a width of 25mm and a gauge length of 200mm, the elongation is to comply with the following minimum values (%).

Thickness(t) mm / Grade	t ≦ 5	5 < t ≦ 10	10 < t ≦ 15	15 < t ≦ 20	20 < t ≦ 25	25 < t ≦ 30	30 < t ≦ 40	40 < t ≦ 50
Grade A/B/D/E	14	16	17	18	19	20	21	22

6. Generally only longitudinal test specimens need to be prepared and tested except for special applications by the purchaser.

7. Charpy V-notch impact tests are generally not required for Grade B steel with thickness of 25mm or less.

8. Impact tests for Grade A steel over 50mm in thickness are not required when the material is produced using fine grain practice and furnished normalizing.

9. Applicable thickness range of this specification is from 6.00 to 50.00mm.

6.1.2.2 CR(2023) Higher-Strength Hull Structural Steel

Grade	Chemical Compositions%												
	C	Si	Mn	P	S	Grain refining elements			Ti	Cu	Cr	Ni	Mo
						Al (acid soluble)	Nb	V					
							Total Content (max.) : 0.12						
AH32 DH32 EH32 AH36 DH36 EH36 AH40 DH40 EH40	0.18 max.	0.50 max.	0.90[(1)]~ 1.60	0.035 max.	0.035 max.	0.015[(2)(3)] max.	0.02[(3)]~ 0.05	0.05[(3)]~ 0.10	0.02 max.	0.35 max.	0.20 max.	0.40 max.	0.08 max.

Remark : 1. Up to a thickness of 12.5mm, the minimum Manganese content may be reduced to 0.70%.

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

3. The steel is to contain Aluminium, Niobium, 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 grain refining element is not applicable.

4. For TMCP(Thermos-Mechanical Controlled Process) steels, Ceq(%) shall conform the value as required as follows. Ceq(%)=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

Grade / Thickness(t) mm	AH32 DH32 EH32	AH36 DH36 EH36	AH40 DH40 EH40
t ≦ 50	0.36 max.	0.38 max.	0.40 max.
50 < t ≦ 100	0.38 max.	0.40 max.	0.42 max.

5. The Applicable thickness range of this specification is from 6.00 to 75.00mm.

Grade	Mechanical Properties						
	Tension Test			Impact Test			
	Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation (%) Test Piece GL=5.65√A	Test Temp °C	Charpy Absorbed Energy Average (J)[2] Long. (Trans.)[3] Thickness (t) mm		
					t ≦ 50.0	50.0 < t ≦ 70.0	70.0 < t ≦ 75.0
AH32	315 min.	440 ~570	22[1] min.	0	31J (22J)	38J (26J)	46J (31J)
DH32				-20			
EH32				-40			
AH36	355 min.	490 ~630	21[1] min.	0	34J (24J)	41J (27J)	50J (34J)
DH36				-20			
EH36				-40			
AH40	390 min.	510 ~660	20[1] min.	0	39J (26J)	46J (31J)	55J (37J)
DH40				-20			
EH40				-40			

Remark : 1. For full thickness flat tensile test specimens with a width of 25mm and a gauge length of 200mm, the elongation is to comply with the following minimum values (%).

Grade \ Thickness(t)mm	t ≦ 5	5 < t ≦ 10	10 < t ≦ 15	15 < t ≦ 20	20 < t ≦ 25	25 < t ≦ 30	30 < t ≦ 40	40 < t ≦ 50
AH32/DH32/EH32	14	16	17	18	19	20	21	22
AH36/DH36/EH36	13	15	16	17	18	19	20	21
AH40/DH40/EH40	12	14	15	16	17	18	19	20

2. When using test pieces of width less than 10mm, the minimum values shall be corrected as the following table.

Width of Test Specimen W (mm)	Charpy Absorbed Energy (min.)
10.0	E
7.5	5/6*E
5.0	2/3*E

3. Generally only longitudinal test specimens need to be prepared and tested except for special applications by the purchaser.

6.1.3 Steel Plates for boilers and Pressure Vessels

6.1.3.1 CNS 8696-14、JIS G3103-23 Carbon Steel and Molybdenum Alloy Steel Plate for Boilers and Pressure Vessels

Grade	Thickness (t) mm	Chemical Compositions%[1]											
		C	Si	Mn	P	S	Mo	Cu	Ni	Cr	Nb	V	Ti	B
SB410	6.00 ≦ t ≦ 25.0	0.24[2] max.	0.15~0.40	0.90[2] max.	0.020 max.	0.020 max.	0.12 max.	0.40 max.	0.40 max.	0.30 max.	0.02 max.	0.03 max.	0.03 max.	0.0010 max.
	25.0 < t ≦ 50.0	0.27[2] max.												
	50.0 < t ≦ 100	0.29[2] max.												
SB450	6.00 ≦ t ≦ 25.0	0.28[2] max.												
	25.0 < t ≦ 50.0	0.31[2] max.												
	50.0 < t ≦ 100	0.33[2] max.												
SB480	6.00 ≦ t ≦ 25.0	0.31[2] max.		1.20[2] max.										
	25.0 < t ≦ 50.0	0.33[2] max.												
	50.0 < t ≦ 100	0.35[2] max.												
SB450M	6.00 ≦ t ≦ 25.0	0.18 max.		0.90 max.			0.45~0.60							
	25.0 < t ≦ 50.0	0.21 max.												
	50.0 < t ≦ 100	0.23 max.												
SB480M	6.00 ≦ t ≦ 25.0	0.20 max.												
	25.0 < t ≦ 50.0	0.23 max.												
	50.0 < t ≦ 100	0.25 max.												

Remark：1. For CNS 8696, Borbon content shall be less than 0.0008%.

2. SB410、SB450 and SB480: Mn may be increased by 0.06% on each reduction of the specified value of C by 0.01%, provided that the upper limit of the specified value of Mn is 1.50% for the heat analysis value.

Grade	Mechanical Properties								
	Tension Test					Bend Test[5]			
	Yield Point or Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Test Piece[1]	Thickness (t) mm	Elongation %[2][3][4]	Thickness (t) mm	Inside Radius	Bend Angle	Test Piece
SB410	225 min.	410~550	No.1A	6.00 ≦ t ≦ 40.0	21 min.	6.00 ≦ t ≦ 25.0 25.0 < t ≦ 50.0 50.0 < t ≦ 100	0.50t 0.75t 1.00t	180°	Transverse to rolling direction
			No.1A	40.0 < t ≦ 50.0	21 min.				
			No.10		25 min.				
			No.10	50.0 < t ≦ 100	25 min.				
SB450	245 min.	450~590	No.1A	6.00 ≦ t ≦ 40.0	19 min.	6.00 ≦ t ≦ 25.0 25.0 < t ≦ 100	0.75t 1.00t	180°	
			No.1A	40.0 < t ≦ 50.0	19 min.				
			No.10		23 min.				
			No.10	50.0 < t ≦ 100	23 min.				
SB480	265 min.	480~620	No.1A	6.00 ≦ t ≦ 40.0	17 min.	6.00 ≦ t ≦ 50.0 50.0 < t ≦ 100	1.00t 1.25t	180°	
			No.1A	40.0 < t ≦ 50.0	17 min.				
			No.10		21 min.				
			No.10	50.0 < t ≦ 100	21 min.				
SB450M	255 min.	450~590	No.1A	6.00 ≦ t ≦ 40.0	19 min.	6.00 ≦ t ≦ 25.0 25.0 < t ≦ 100	0.50t 0.75t	180°	
			No.1A	40.0 < t ≦ 50.0	19 min.				
			No.10		23 min.				
			No.10	50.0 < t ≦ 100	23 min.				
SB480M	275 min.	480~620	No.1A	6.00 ≦ t ≦ 40.0	17 min.	6.00 ≦ t ≦ 25.0 25.0 < t ≦ 100	0.75t 1.00t	180°	
			No.1A	40.0 < t ≦ 50.0	17 min.				
			No.10		21 min.				
			No.10	50.0 < t ≦ 100	21 min.				

Remark : 1. For the tensile test pieces, No.1A test piece shall be used for the steel plates of 50mm or under in thickness and No.10 test piece for those of over 50mm in thickness. However, for the steel plates of over 40mm in thickness, No.10 test piece may be used.

2. For the elongation of No.1A test piece for steel plates under 8mm in thickness, deduct 1% from the elongation values given in the above table for each decrement of 1mm or its fraction in thickness.

3. For the elongation of No.10 test piece for steel plates over 90mm in thickness, deduct 0.5% from the elongation values given in the above table for each increment of 12.5mm or its fraction in thickness. However, the deduction shall not exceed 3%.

4. For No.1A test piece of SB450M and SB480M steel plate with a thickness over 6mm to and excluding 20mm, if the measured elongation is more than the value (%) specified in this table subtracted by 3%, the steel plate shall pass the test provided the elongation measured over the gage length 50mm including the fractured part is 25% or greater.

5. Unless specially designated by the purchaser, the bend test may be omitted.

6.1.3.2 JIS G3115-22 Steel Plates for Pressure Vessels for Intermediate Temperature Service

Grade	Thickness (t) mm	Chemical Compositions%				
		C	Si	Mn	P	S
SPV235	6.00 ≦ t ≦ 100.0	0.18 max.	0.35 max.	1.40 max.	0.020 max.	0.020 max.
	100.0 < t ≦ 150.0	0.20 max.				
SPV315	6.00 ≦ t ≦ 150.0	0.18 max.	0.55 max.	1.60 max.		
SPV355	6.00 ≦ t ≦ 150.0	0.20 max.	0.55 max.	1.60 max.		
SPV410	6.00 ≦ t ≦ 150.0	0.18 max.	0.75 max.	1.60 max.		

Remark：1. Alloy elements other than those shown in the above table may be added if necessary.
2. Applicable thickness range of this specification is from 6.00 to 50.00mm.
3. When Grade SPV315、SPV355 及 SPV410 are subjected to thermos-mechanical controlled processing, Ceq(%) shall conform the table below. Ceq(%) =C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14.

Grade	Ceq (%)		
	Thickness Range		
	50.00mm max.	50.01~100.0mm	100.1~150.0mm
SPV315	0.39 max.	0.41 max.	0.43 max.
SPV355	0.40 max.	0.42 max.	0.44 max.
SPV410	0.43 max.	0.45 max.	–

Grade	Mechanical Properties												
	Tension Test							Bend Test			Impact Test		
	Yield Point or Yield Strength (N/mm²)			Tensile Strength (N/mm²)	Elongation			Inside Radius	Bend Angle	Test Piece	Test Temp ℃	Charpy Absorbed Energy (J)	Test Piece
	Thickness(t) mm				Thickness (t) mm	Test Piece	% (min.)					AVG / IDV	
	t ≦ 50	50 < t ≦ 100	100 < t ≦ 150										
SPV235	235 min.	215 min.	195 min.	400 ~510	6.00 ≦ t ≦ 16.0	No.1A	17	1.00t	180°	No.1, Transverse to rolling direction	0	47 min. / 27 min.	V-notch, Parallel to rolling direction
					16.0 < t ≦ 40.0	No.1A	21						
					40.0 < t ≦ 50.0	No.1A	21						
						No.4	24						
					50.0 < t ≦ 150.0	No.1A	21						
						No.4	24						
SPV315	315 min.	295 min.	275 min.	490 ~610	6.00 ≦ t ≦ 16.0	No.1A	16	1.50t	180°		0		
					16.0 < t ≦ 40.0	No.1A	20						
					40.0 < t ≦ 150.0	No.1A	20						
						No.4	23						
SPV355	355 min.	335 min.	315 min.	520 ~640	6.00 ≦ t ≦ 16.0	No.1A	14	1.50t	180°		0		
					16.0 < t ≦ 40.0	No.1A	18						
					40.0 < t ≦ 150.0	No.1A	18						
						No.4	21						
SPV410	410 min.	390 min.	370 min.	550 ~670	6.00 ≦ t ≦ 16.0	No.1A	12	1.50t	180°		-10		
					16.0 < t ≦ 40.0	No.1A	16						
					40.0 < t ≦ 150.0	No.1A	16						
						No.4	18						

Remark：Impact test is applicable to thickness over 12.0mm of steel.

6.1.3.3 ASTM A285-17 Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength

Grade	Chemical Compositions%				Mechanical Properties			
					Tension Test			
	C	Mn	P	S	Yield Strength ksi(N/mm^2)	Tensile Strength ksi(N/mm^2)	Elongation	
							Test Piece in.(mm)	%
Grade A	0.17 max.	0.90 max.	0.025 max.	0.025 max.	24(165) min.	45~65 (310~450)	GL=8(200) GL=2(50)	27 min. 30 min.
Grade B	0.22 max.				27(185) min.	50~70 (345~485)	GL=8(200) GL=2(50)	25 min. 28 min.
Grade C	0.28 max.				30(205) min.	55~75 (380~515)	GL=8(200) GL=2(50)	23 min. 27 min.

Remark：1. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A20 for elongation adjustment.
2. Applicable thickness range of this specification is from 6.00 to 50.80mm.

6.1.3.4 ASTM A515-17 Pressure Vessel Plates, Carbon Steel, for Intermediate- and High-Temperature Service

Grade	Thickness (t) mm	Chemical Compositions%					Mechanical Properties			
							Tension Test			
		C	Si	Mn	P	S	Yield Strength ksi(N/mm^2)	Tensile Strength ksi(N/mm^2)	Elongation	
									Test Piece in.(mm)	%
Grade 60	t ≦ 25.40	0.24 max.	0.15 ~0.40	0.90 max.	0.025 max.	0.025 max.	32(220) min.	60~80 (415~550)	GL=8(200) GL=2(50)	21 min. 25 min.
	25.40 < t ≦ 50.80	0.27 max.								
	50.80 < t ≦ 101.6	0.29 max.								
Grade 65	t ≦ 25.40	0.28 max.		0.90 max.			35(240) min.	65~85 (450~585)	GL=8(200) GL=2(50)	19 min. 23 min.
	25.40 < t ≦ 50.80	0.31 max.								
	50.80 < t ≦ 101.6	0.33 max.								
Grade 70	t ≦ 25.40	0.31 max.		1.20 max.			38(260) min.	70~90 (485~620)	GL=8(200) GL=2(50)	17 min. 21 min.
	25.40 < t ≦ 50.80	0.33 max.								
	50.80 < t ≦ 101.6	0.35 max.								

Remark：1. When the thickness is less than 5/16 in.(8mm), see Specification ASTM A20 for elongation adjustment.
2. For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.50%.
3. Plates over 2 in.(50.8mm) in thickness shall be normalized.

6.1.3.5 ASTM A516-17 Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Service

Grade	Thickness (t) mm	Chemical Compositions%					Mechanical Properties			
							Tension Test			
		C	Si	Mn	P	S	Yield Strength ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Elongation	
									Test Piece in.(mm)	%
Grade 55	t ≦ 12.70	0.18 max.	0.15 ~0.40	0.60 ~0.90	0.025 max.	0.025 max.	30(205) min.	55~75 (380~515)	GL=8(200) GL=2(50)	23 min. 27 min.
	12.70 < t ≦ 50.80	0.20 max.		0.60 ~1.20						
	50.80 < t ≦ 101.6	0.22 max.		0.60 ~1.20						
Grade 60	t ≦ 12.70	0.21 max.		0.60 ~0.90			32(220) min.	60~80 (415~550)	GL=8(200) GL=2(50)	21 min. 25 min.
	12.70 < t ≦ 50.80	0.23 max.		0.85 ~1.20						
	50.80 < t ≦ 101.6	0.25 max.		0.85 ~1.20						
Grade 65	t ≦ 12.70	0.24 max.		0.85 ~1.20			35(240) min.	65~85 (450~585)	GL=8(200) GL=2(50)	19 min. 23 min.
	12.70 < t ≦ 50.80	0.26 max.								
	50.80 < t ≦ 101.6	0.28 max.								
Grade 70	t ≦ 12.70	0.27 max.		0.85 ~1.20			38(260) min.	70~90 (485~620)	GL=8(200) GL=2(50)	17 min. 21 min.
	12.70 < t ≦ 50.80	0.28 max.								
	50.80 < t ≦ 101.6	0.30 max.								

Remark：1. When the thickness is less than 5/16 in.(8mm), see specification ASTM A20 for elongation adjustment.

2. For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum is permitted, up to a maximum of 1.50%.

3. For Grade 60, 1/2 in.(12.7mm) and under in thickness may have 0.85~1.20% manganese on heat analysis.

4. Plates over 1.50 in.(38.1mm) in thickness shall be normalized.

6.1.3.6 ASTM A537-20 Pressure Vessel Plates, Heat-treated, Carbon-Manganese-Silicon Steel

Grade	Thickness (t) mm	Chemical Compositions%									Mechanical Properties			
											Tension Test			
													Elongation	
		C	Si	Mn	P	S	Cu	Ni	Cr	Mo	Yield Strength ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Test Piece in.(mm)	% (min.)
Class 1	6.00 ≦ t ≦ 38.10	0.24 max.	0.15 ~ 0.50	0.70 ~ 1.35	0.025 max.	0.025 max.	0.35 max.	0.25 max.	0.25 max.	0.08 max.	50(345) min.	70~90 (485~620)	GL=8(200) GL=2(50)	18 22
	38.10 < t ≦ 50.80			1.00 ~ 1.60										

Remark : 1. When the thickness is 1.50in.(38.1mm) and under, manganese may exceed 1.35%, up to a maximum of 1.60%, and nickel may exceed 0.25%, 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+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

2. When the thickness is less than 5/16 in.(8mm), see specification ASTM A20 for elongation adjustment.

3. Class 1(All thickness) plates shall be normalized.

6.1.3.7 ASTM A841-17 GR.B CL.2 (Steel Plates for Pressure Vessel, Produced by TMCP)

Thickness (t) mm	Chemical Compositions%						Mechanical Properties					
							Tension Test				Impact Test	
									Elongation			
	C	Si	Mn	P	S	Total Al	Yield Strength ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Test Piece in.(mm)	%	Test Temp/ Test Piece	Charpy Absorbed Energy
15.00 ≦ t ≦ 38.10	0.15 max.	0.15 ~0.50	0.70 ~1.35	0.030 max.	0.025 max.	0.020 min.	60(415) min.	80~100 (550~690)	GL=2(50)	22 min.	-40℃ / Parallel to rolling direction	20J min.
38.10 < t ≦ 63.50			1.00 ~1.60									

Remark : 1. Other chemical compositions requirement, Cu:0.35max., Ni:0.60max., Cr:0.25max., Mo:0.30max., Nb:0.03max., V:0.06max..

2. By agreement, the steel may be produced with titanium, in which case the minimum aluminum content shall not apply. When this option is exercised, the titanium content, by heat analysis, shall be 0.006% to 0.02%.

3. When the thickness 1.50in.(38.1mm) and under, manganese may exceed 1.35%, up to a maximum of 1.60%, provided the heat analysis carbon equivalent does not exceed 0.47% when based upon the following equation: CE = C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

6.1.4 Steel Plates for Machine Structural Usage

6.1.4.1 CNS 3828-14、JIS G4051-23 Carbon Steels for Machine Strctural Use

Grade	Thickness[1] (t) mm	Chemical Compositions%								
		C	Si	Mn	P	S	Ni	Cr[2]	Cu	Ni+Cr[3]
S10C	t ≧ 7.90	0.08~0.13	0.15~0.35	0.30~0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S12C	t ≧ 7.90	0.10~0.15								
S15C	t ≧ 7.90	0.13~0.18								
S17C	t ≧ 7.90	0.15~0.20								
S20C	t ≧ 7.90	0.18~0.23								
S22C	t ≧ 7.90	0.20~0.25								
S25C	t ≧ 7.90	0.22~0.28								
S28C	t ≧ 7.90	0.25~0.31	0.15~0.35	0.60~0.90	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S30C	t ≧ 7.90	0.27~0.33								
S33C	t ≧ 7.90	0.30~0.36								
S35C	t ≧ 7.90	0.32~0.38								
S38C	t ≧ 7.90	0.35~0.41								
S40C	t ≧ 7.90	0.37~0.43								
S43C	t ≧ 7.90	0.40~0.46								
S45C	t ≧ 7.90	0.42~0.48								
S48C	t ≧ 7.90	0.45~0.51								
S50C	t ≧ 7.90	0.47~0.53								
S53C	t ≧ 7.90	0.50~0.56								
S55C	t ≧ 7.90	0.52~0.58								
S58C*	t ≧ 7.90	0.55~0.61								

Remark : 1. The upper limit of thickness shall be inquiry before placing the order. The forging ratio shall is not less than 4S unless otherwise specified.

2. Cr may be specified as values under 0.30% upon the agreement betweenthe manufacturer and the purchaser.

3. Ni+Cr may be specified as values under 0.40% upon the agreement between the manufacturer and the purchaser.

6.1.4.2 JIS G4053-23 SCM440 (Low-alloyed Steels for Machine Strctural Use) [1]

Thickness[2](t) mm	Chemical Compositions%								
	C	Si	Mn	P	S	Ni	Cr	Cu	Mo
12.00 ≦ t ≦ 125.0	0.38~ 0.43	0.15~ 0.35	0.60~ 0.90	0.030 max.	0.030 max.	0.25 max.	0.90~ 1.20	0.30 max.	0.15~ 0.30

Remark：1. This is applicable afterwards quenching and tempering process.
2. The forging ratio shall be not less than 4S unless otherwise specified. The steel plate with thickness below 65.0mm produced by CSC can meet the forging ratio requirements.

6.1.4.3 CSC PZ30H (Plates for Die of pressing) [1][2]

Thickness (t) mm	Chemical Compositions%								
	C	Si	Mn	P	S	Ni	Cr	Cu	Mo
15.00 ≦ t ≦ 85.00	0.35 max.	–	0.80 min.	–	–	–	1.70 max.	–	0.45 max.

Remark：1. There is no mechanical properties requirements for CSC PZ30H (plates for die of pressing).
2. This is applicable afterwards quenching and tempering process.

6.1.4.4 CSC PC1050 (Machine Structural Usage (over-thickness)) [1]

Thickness[2](t) mm	Chemical Compositions%								
	C	Si	Mn	P	S	Ni	Cr[3]	Cu	Ni+Cr[4]
125.0 < t	0.47~ 0.53	0.15~ 0.35	0.60~ 0.90	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.

Remark：1. The forging ratio is less than 4S.
2. The upper limit of thickness shall be inquiry before placing the order.
3. Cr may be specified as values under 0.30% upon the agreement between the manufacturer and the purchaser.
4. Ni+Cr may be specified as values under 0.40% upon the agreement between the manufacturer and the purchaser.

6.1.4.5 SAE J403-24 Chemical Compositions of SAE Carbon Steels

Grade	Thickness[1] (t) mm	Chemical Compositions %				
		C	Si	Mn	P	S
1005	t ≧ 7.90	0.06 max.	—	0.35 max.	0.030 max.	0.035 max.
1006	t ≧ 7.90	0.08 max.		Remark[2]		
1008	t ≧ 7.90	0.10 max.		Remark[3]		
1009	t ≧ 7.90	0.15 max.		0.60 max.		
1010	t ≧ 7.90	0.08~0.13		0.30~0.60		
1012	t ≧ 7.90	0.10~0.15		0.30~0.60		
1013	t ≧ 7.90	0.11~0.16		0.30~0.60		
1015	t ≧ 7.90	0.13~0.18		0.30~0.60		
1016	t ≧ 7.90	0.13~0.18		0.60~0.90		
1017	t ≧ 7.90	0.15~0.20		0.30~0.60		
1018	t ≧ 7.90	0.15~0.20		0.60~0.90		
1019	t ≧ 7.90	0.15~0.20		0.70~1.00		
1020	t ≧ 7.90	0.18~0.23		0.30~0.60		
1021	t ≧ 7.90	0.18~0.23		0.60~0.90		
1022	t ≧ 7.90	0.18~0.23		0.70~1.00		
1023	t ≧ 7.90	0.20~0.25		0.30~0.60		
1025	t ≧ 7.90	0.22~0.28		0.30~0.60		
1026	t ≧ 7.90	0.22~0.28		0.60~0.90		
1029	t ≧ 7.90	0.25~0.31		0.60~0.90		
1030	t ≧ 7.90	0.28~0.34		0.60~0.90		
1033	t ≧ 7.90	0.30~0.36		0.70~1.00		
1035	t ≧ 7.90	0.32~0.38		0.60~0.90		
1037	t ≧ 7.90	0.32~0.38		0.70~1.00		
1038	t ≧ 7.90	0.35~0.42		0.60~0.90		
1039	t ≧ 7.90	0.37~0.44		0.70~1.00		
1040	t ≧ 7.90	0.37~0.44		0.60~0.90		
1042	t ≧ 7.90	0.40~0.47		0.60~0.90		
1043	t ≧ 7.90	0.40~0.47		0.70~1.00		
1044	t ≧ 7.90	0.43~0.50		0.30~0.60		
1045	t ≧ 7.90	0.43~0.50		0.60~0.90		
1046	t ≧ 7.90	0.43~0.50		0.70~1.00		
1049	t ≧ 7.90	0.46~0.53		0.60~0.90		
1050	t ≧ 7.90	0.48~0.55		0.60~0.90		
1053	t ≧ 7.90	0.48~0.55		0.70~1.00		
1055	t ≧ 7.90	0.50~0.60		0.60~0.90		
1060*	t ≧ 7.90	0.55~0.65		0.60~0.90		

Remark：1. The upper limit of thickness shall be inquiry before placing the order.

2. Grade 1006:

(1) For Structural Shapes, Plates, Strip, Sheets and Welded Tubing, Mn(%) shall be 0.45% max..

(2) For Semi-Finished Products for Forging, Hot Rolled and Cold Finished Bars, Wire Rods and Seamless Tubing, Mn(%) shall be 0.25~0.45%.

3. Grade 1008:

(1) For Structural Shapes, Plates, Strip, Sheets and Welded Tubing, Mn(%) shall be 0.50% max..

(2) For Semi-Finished Products for Forging, Hot Rolled and Cold Finished Bars, Wire Rods and Seamless Tubing, Mn(%) shall be 0.30~0.50%.

6.1.4.6 SAE J404-09 Chemical Compositions of SAE Alloy Steels

Grade	Thickness[1] (t) mm	Chemical Compositions %				
		C	Si	Mn	P	S
1330	t ≧ 7.90	0.28~0.33	0.15~0.35	1.60~1.80	0.030 max.	0.040 max.
1335	t ≧ 7.90	0.33~0.38	0.15~0.35	1.60~1.90		
1340	t ≧ 7.90	0.38~0.43	0.15~0.35			
1345	t ≧ 6.00	0.43~0.48	0.15~0.35			

Remark：1. The upper limit of thickness shall be inquiry before placing the order.

6.1.5 Atmospheric Corrosion Resistant Steel Plates

6.1.5.1 JIS G3114-22 Hot-Rolled Atmospheric Corrosion Resisting Steels for Welded Structure

Grade		Chemical Compositions %							
		C	Si	Mn	P	S	Cu	Cr	Ni
SMA400 A.B.C.	W	0.18 max.	0.15~0.65	1.25 max.	0.035 max.	0.035 max.	0.30~0.50	0.45~0.75	0.05~0.30
	P		0.55 max.				0.20~0.35	0.30~0.55	–
SMA490 A.B.C.	W	0.18 max.	0.15~0.65	1.40 max.	0.035 max.	0.035 max.	0.30~0.50	0.45~0.75	0.05~0.30
	P		0.55 max.				0.20~0.35	0.30~0.55	–
SMA570	W	0.18 max.	0.15~0.65	1.40 max.	0.035 max.	0.035 max.	0.30~0.50	0.45~0.75	0.05~0.30
	P		0.55 max.				0.20~0.35	0.30~0.55	–

Remark：1. The letter symbol 『W』 denotes that the plates are usually used with nothing on it or only chemically treated against rusting, while 『P』 denotes that they are usually used after being coated.

2. If necessary, the elements that are effective for the atmospheric corrosion resistance, such as Mo, Nb, Ti and V, may be added. in which case, the total content of these elements shall not be over 0.15%.

3. When Grade SMA490A, SMA490B, SMA490C and SMA570 are subjected to thermos-mechanical controlled processing, Ceq (%) shall conform the table below. Ceq(%) = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14.

Grade		Ceq (%)	
		Thickness Range	
		50.00mm max.	50.01~75.0mm
SMA490 A.B.C	W	0.41 max.	0.43 max.
	P	0.40 max.	0.42 max.
SMA570	W	0.44 max.	0.47 max.
	P		

4. Grade SMA570 shall be inquiry before placing the order.

5. Applicable thickness range of this specification is from 6.00 to 50.00mm.

Grade		Mechanical Properties										
		Tension Test							Impact Test			
		Yield Point or Yield Strength (N/mm²)			Tensile Strength (N/mm²)	Elongation			Symbol	Test Temp ℃	Charpy Absorbed Energy Average (J)	Test piece
		Thickness (t) mm				Thickness (t) mm	Test Piece	% (min.)				
		t ≦ 16	16 < t ≦ 40	40 < t ≦ 75								
SMA400 A.B.C.	W	245 min.	235 min.	215 min.	400 ~540	t ≦ 16	No.1A	17	A	–	–	V-notch, Parallel to rolling direction
						t > 16	No.1A	21	B	0	27 min.	
	P					t > 40	No.4	23	C	0	47 min.	
SMA490 A.B.C.	W	365 min.	355 min.	335 min.	490 ~610	t ≦ 16	No.1A	15	A	–	–	
						t > 16	No.1A	19	B	0	27 min.	
	P					t > 40	No.4	21	C	0	47 min.	
SMA570	W	460 min.	450 min.	430 min.	570 ~720	t ≦ 16	No.5	19	–	-5	47 min.	
						t > 16	No.5	26				
	P					t > 20	No.4	20				

Remark：Impact test is applied only to the plates exceeding 12.0mm in thickness.

6.1.5.2 ASTM A242-13 High-Strength Low-alloy Structural Steel

Grade	Chemical Compositions %					Mechanical Properties				
						Tension Test				
	C	Mn	P	S	Cu	Thickness (t) mm	Yield Point ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Elongation	
									Test Piece in.(mm)	%
Type 1	0.15 max.	1.00 max.	0.15 max.	0.05 max.	0.20 min.	t ≦ 19.05	50(345) min.	70(480) min.	GL=8(200) GL=2(50)	18 min. 21 min.
						19.05 < t ≦ 38.10	46(315) min.	67(460) min.		
						38.10 < t ≦ 101.6	42(290) min.	63(435) min.		

Remark：1. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.
2. When the thickness is less than 5/16 in.(8mm), see Specification A6 for elongation adjustment.

6.1.5.3 ASTM A588-19 HSLA Structural Steel up to 50 ksi min. Yield Point, Atmospheric Corrosion Resistance

Grade	Chemical Compositions %											Mechanical Properties			
												Tension Test			
														Elongation	
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Test Piece in.(mm)	%
Grade A	0.19 max.	0.30 ~0.65	0.80 ~1.25	0.030 max.	0.030 max.	0.25 ~0.40	0.40 max.	0.40 ~0.65	–	0.02 ~0.10	–	50(345) min.	70(485) min.	GL= 8(200) GL= 2(50)	18 min. 21 min.
Grade B	0.20 max.	0.15 ~0.50	0.75 ~1.35			0.20 ~0.40	0.50 max.	0.40 ~0.70	–	0.01 ~0.10	–				
Grade K	0.17 max.	0.25 ~0.50	0.50 ~1.20			0.30 ~0.50	0.40 max.	0.40 ~0.70	0.10 max.	–	0.005 ~0.05				

Remark：1. For each reduction of 0.01% below the specified maximum for carbon, an increase of 0.06% above the specified maximum for manganese is permitted, up to a maximum of 1.50%.

2. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%.

3. When the thickness is less than 5/16 in.(8mm), see Specification A6 for elongation adjustment.

4. Grade K for plates under 1/2 in.(12.70mm) in thickness, the minimum columbium(niobium) is waived.

5. Applicable thickness range of this specification is from 6.00 to 50.80mm.

6.1.5.4 CSC Steel plate for Sulfur Dew-Point Corrosion-Resistance

Grade	Thickness (t) mm	Chemical Compositions %								
		C	Si	Mn	P	S	Cu	Ni	Cr	Ti
SCR TEN2	6.00 ≦ t ≦ 20.00	0.14 max.	0.15~ 0.55	0.90 max.	0.025 max.	0.035 max.	0.20~ 0.50	0.50 max.	0.50~ 1.00	0.15 max.
Grade	Thickness (t) mm	C	Si	Mn	P	S	Cu	Ni	Cr	Sb
SCR TEN3	6.00 ≦ t ≦ 20.00	0.14 max.	0.15~ 0.55	0.90 max.	0.035 max.	0.035 max.	0.25~ 0.50	–	0.80~ 1.30	0.15 max.

Grade	Thickness (t) mm	Tension Test				Bend Test		
		Yield Point (N/mm²)	Tensile Strength (N/mm²)	Elongation	Test Piece	Bend Angle	Inside Radius	Test Piece
SCR TEN2	6.00 ≦ t ≦ 20.00	325 min.	440 min.	18% min.	No.1A	180°	1.5t	No.1
Grade	Thickness (t) mm	Yield Point (N/mm²)	Tensile Strength (N/mm²)	Elongation	Test Piece	Bend Angle	Inside Radius	Test Piece
SCR TEN3	6.00 ≦ t ≦ 20.00	325 min.	440 min.	22% min.	No.5	180°	1.5t	No.1

6.1.5.5 CSC Steel plate for Galvanizing Pot

Grade	Thickness (t) mm	Chemical Compositions %				
		C	Si	Mn	P	S
GP1	6.00 ≦ t ≦ 50.80	0.07 max.	0.02 max.	0.35 max.	0.020 max.	0.020 max.
GP2		0.15~0.25	0.03 max.	0.90 max.	0.012 max.	

6.1.6 Steel Plates for API 5L-2018 (ISO 3183) Line Pipe Usage

Type of pipe	PSL	Grade	Thickness (t) mm	Chemical Compositions %											Tension Test	
				C	Mn	P	S	Si	Nb	V	Ti	Nb+V+Ti	CE_{iiw}	CE_{pcm}	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)
Welded	PSL 1	A	6.00 ≦ t ≦ 50.80	0.22 max.	0.90 max.	0.030 max.	0.030 max.	–	–	–	–	–	–	–	210 min.	335 min.
		B	6.00 ≦ t ≦ 50.80	0.26 max.	1.20 max.	0.030 max.	0.030 max.	–	Nb+V: 0.06 max.(5)		–	0.15 max.	–	–	245 min.	415 min.
		X42	6.00 ≦ t ≦ 27.00	0.26 max.	1.30 max.	0.030 max.	0.030 max.	–	–	–	–	0.15 max.	–	–	290 min.	415 min.
		X46	–		1.40 max.										320 min.	435 min.
		X52	7.93 ≦ t ≦ 27.00		1.40 max.										360 min.	460 min.
		X56	–		1.40 max.										390 min.	490 min.
		X60	9.00 ≦ t ≦ 19.50	0.26 max.	1.40 max.	0.030 max.	0.030 max.	–	–	–	–	0.15 max.(6)	–	–	415 min.	520 min.
		X65	10.00 ≦ t ≦ 26.00		1.45 max.										450 min.	535 min.
		X70	15.00 ≦ t ≦ 30.00		1.65 max.										485 min.	570 min.
	PSL 2	BM	15.00 ≦ t ≦ 50.80	0.22 max.	1.20 max.	0.025 max.	0.015 max.	0.45 max.	0.050 max.	0.050 max.	0.040 max.	–	0.43 max.	0.25 max.	245 ~450	415 ~655
		X42M	15.00 ≦ t ≦ 27.00	0.22 max.	1.30 max.										290 ~495	415 ~655
		X46M	–		1.30 max.										320 ~525	435 ~655
		X52M	15.00 ≦ t ≦ 27.00	0.22 max.	1.40 max.	0.025 max.	0.015 max.	0.45 max.	–	–	–	0.15 max.	0.43 max.	0.25 max.	360 ~530	460 ~760
		X56M	–		1.40 max.										390 ~545	490 ~760
		X60M	15.00 ≦ t ≦ 19.50	0.12 max.	1.60 max.	0.025 max.	0.015 max.	0.45 max.	–	–	–	0.15 max.(6)	0.43 max.	0.25 max.	415 ~565	520 ~760
		X65M	15.00 ≦ t ≦ 26.00		1.60 max.										450 ~600	535 ~760
		X70M	15.00 ≦ t ≦ 30.00		1.70 max.										485 ~635	570 ~760

Remark : 1. For each reduction of 0.01% below the specified maximum concentration for carbon, an increase of 0.05% above the specified maximum concentration for manganese is permissible, but maximum concentration is applied as follows:
(1) Grade B、X42、X46、X52 and Grade BM、X42M、X46M、X52M: Maximum for [Mn] is 1.65%.
(2) Grade X56、X60、X65 and Grade X56M、X60M、X65M: Maximum for [Mn] is 1.75%.
(3) Grade X70 and X70M: Maximum for [Mn] is 2.00%.

2. Niobium, vanadium, or combinations may be used at the discretion of the manufacturer.
3. Alloy elements other than those shown in the above table may be added upon the agreement betweenthe manufacturer and the purchaser.
4. Elongation values are according to Specification of API 5L-2007 (ISO 3183).
5. Grade B: Unless otherwise agreed, the sum of niobium and vanadium contents shall be 0.06% max..
6. Grade X60、X65、X70 and Grade X60M、X65M、X70M: Unless otherwise agreed, the sum of the niobium, vanadium, and titanium contents shall be 0.15% max.
7. CEiiw(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.
8. CEpcm(%)= C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mn/15+V/10+5B.

6.1.7 Steel Plates for Special Usage

6.1.7.1 CNS 2473-14、JIS G3101-24 SS400 LC (Plates for Laser Cutting use)

Thickness (t) mm	Chemical Compositions %					Mechanical Properties					
						Tension Test					
						Yield Point or Yield Strength (N/mm²)		Tensile Strength (N/mm²)	Elongation		
						Thickness (t) mm			Thickness (t) mm	Test Piece	%
	C	Mn	P	S	Si	12.00 ≦ t ≦ 16.00	16.00 < t ≦ 25.00				
12.00 ≦ t ≦ 25.00	0.25 max.	1.35 max.	0.030 max.	0.030 max.	0.50 max.	245 min.	235 min.	400~510	12.00 ≦ t ≦ 16.00	No.1A	17 min.
									16.00 < t ≦ 25.00		21 min.

Remark：For CNS 2473 SS400 LC, Borbon content shall be less than 0.0008%.

6.1.7.2 CSC PH490TB (Fire resistant Steel Plates)

Thickness (t) mm	Chemical Compositions %						Mechanical Properties							
							Tension Test					Impact Test		
										Elongation (No.1A)				
										Thickness (t) mm				
	C	Si	Mn	P	S	Ceq	Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Yield Ratio %	12.00 < t ≦ 16.00	16.00 < t ≦ 30.00	Test Temp ℃	Charpy Absorbed Energy Averag	Test Piece
12.00 < t ≦ 30.00	0.18 max.	0.55 max.	1.60 max.	0.030 max.	0.015 max.	0.44 max.	325~445	490~610	80 max.	17 min.	21 min.	0	27J min.	No.4, Parallel to rolling direction

Remark：In 600℃ service, the product could be maintained by 2/3 yield strength of room temperature.

6.1.7.3 ASTM A516-17 HIC (Pressure vessel Plates of Hydrogen Induced Crack resistant)

Grade	Thickness (t) mm	Chemical Compositions %						Mechanical Properties			
								Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation	
										Test Piece	%
		C	Si	Mn	P	S	Ceq				
GR.60	6.00 ≦ t ≦ 50.80	0.20 max.	0.15 ~0.40	0.85 ~1.20	0.010 max.	0.003 max.	0.42 max.	220 min.	415~550	No.1A	21 min.
	50.80 < t ≦ 58.00									No.4	25 min.
GR.70	6.00 ≦ t ≦ 50.80	0.20 max.	0.15 ~0.40	0.85 ~1.20	0.010 max.	0.002 max.	0.45 max.	260 min.	485~620	No.1A	17 min.

Remark：1. The guarantee of crack length ratio (CLR) shall be 15% max. unless agreement between purchaser and manufacturer.
2. Ceq(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.
3. The product specification shall be Normalized and Simulated Post Weld Heat Treatment.

6.1.8 Chemical Composition and Mechanical Property for New Products

6.1.8.1 CSC PA400H、PA500H 及 AR400F (Abrasion Resistant Steel Plate)

Grade	Thickness (t) mm	Chemical Compositions %											Hardness Test HBW[2][3]	Impact Test[4]	
		C (max)	Mn (max)	P (max)	S (max)	Si (max)	Ni (max)	Cr (max)	Mo (max)	B (max)	Ca (min)	Ceq[1] (max)		Test Temp	Charpy Absorbed Energy Averag[5]
PA400H	10.00-20.00	0.32	1.60	0.025	0.010	0.70	1.50	1.40	0.60	0.005	-	0.47	370-430	-	
	20.01-32.00											0.52			
	32.01-50.00											0.61			
PA500H	12.00-20.00	0.30	1.60	0.020	0.010	0.70	1.50	1.50	0.60	0.005	-	0.64	470-530	-	
	20.01-30.00											0.66			
AR400F	09.53-50.80	0.32	1.60	0.025	0.010	0.70	1.50	1.40	0.60	0.004	0.0008	-	370-430	-40℃	34J min.

Remark：1. Ceq(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

2. Hardenss test is carried out on a milled surface 1.5mm below the plate surface.

3. Plates are through-hardened to a minimum of 90% of the guaranteed minimum surface hardness.

4. Test piece is V-notch, and direction parallel to rolling direction.

5. According to ISO 148, when using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece. Also, single value minimum is 70% of specified average value.

6.1.8.2 EN10025-4 (2019) S355ML、S420ML 及 S460ML (Structural steels for thermo-mechanical rolled weldable fine grain)

Grade	Chemical Compositions %														Ceq[1]			
	C (max)	Mn (max)	P (max)	S (max)	Si (max)	Nb (max)	V (max)	T.Al (min)	Ti (max)	Cr (max)	Ni (max)	Mo (max)	Cu (max)	N (max)	16.00mm max.	16.01-40.00mm	40.01-63.00mm	63.01-150.0mm
S355ML	0.14	1.60	0.025	0.020	0.50	0.05	0.10	0.02	0.05	0.30	0.50	0.10	0.55	0.015	0.39 max.	0.39 max.	0.40 max.	0.45 max.
S420ML	0.16	1.70	0.025	0.020	0.50	0.05	0.12	0.02	0.05	0.30	0.80	0.20	0.55	0.025	0.43 max.	0.45 max.	0.46 max.	0.47 max.
S460ML	0.16	1.70	0.025	0.020	0.60	0.05	0.12	0.02	0.05	0.30	0.80	0.20	0.55	0.025	0.45 max.	0.46 max.	0.47 max.	0.48 max.

Remark：1. Ceq(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

Grade	Tension Test(1)												Impact Test(2)	
	Yield Strength (N/mm²)						Tensile Strength (N/mm²)					Elongation	Test Temp	Charpy Absorbed Energy Averag(3)
	16 mm max.	16mm < t ≦ 40mm	40mm < t ≦ 63mm	63mm < t ≦ 80mm	80mm < t ≦ 100mm	100mm < t ≦ 150mm	40 mm 以下	40mm < t ≦ 63mm	63mm < t ≦ 80mm	80mm < t ≦ 100mm	100mm < t ≦ 150mm	L_0= 5.65S_0		
S355ML	355 min.	345 min.	335 min.	325 min.	325 min.	320 min.	470 ~630	450 ~610	440 ~600	440 ~600	430 ~590	22% min.	-50℃	27J min.
S420ML	420 min.	400 min.	390 min.	380 min.	370 min.	365 min.	520 ~680	500 ~660	480 ~640	470 ~630	460 ~620	19% min.	-50℃	27J min.
S460ML	460 min.	440 min.	430 min.	410 min.	400 min.	385 min.	540 ~760	530 ~710	510 ~690	500 ~680	490 ~660	17% min.	-50℃	27J min.

Remark：1. For plate, strip and wide flats with widths ≥ 600mm, the direction transverse to the rolling direction applies. For all other products, the values apply for the direction parallel to the rolling direction.

2. Test piece is V-notch, and direction parallel to rolling direction. Another temperature (given in the table below) may be agreed upon at the time of the order.

Test Temp(℃)	+20	0	-10	-20	-30	-40	-50
Charpy Absorbed Energy Averag(J)	63 min.	55 min.	51 min.	47 min.	40 min.	31 min.	27 min.

3. Using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.

6.1.8.3 EN10025-6 (2019) S690QL 及 S890QL (Structural steels for high yield strength in the quenched and tempered condition)

Grade	Chemical Compositions %															
	C (max)	Mn (max)	P (max)	S (max)	Si (max)	Nb (max)	V (max)	Ti (max)	Cr (max)	Ni (max)	Mo (max)	Cu (max)	N (max)	B (max)	Ceq(1) 50.00mm max.	Ceq(1) 50.01-100.0mm	Ceq(1) 100.1-125.0mm	Ceq(1) 125.1-200.0mm
S690QL	0.20	1.70	0.020	0.010	0.80	0.06	0.12	0.05	1.50	4.0	0.70	0.50	0.015	0.005	0.65 max.	0.77 max.	0.83 max.	0.83 max.
S890QL															0.72 max.	0.82 max.	0.83 max.	-

Remark：Ceq(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

Grade	Mechanical Properties										
	Tension Test(1)									Impact Test(2)	
	Yield Strength (N/mm²)				Tensile Strength (N/mm²)				Elongation	Test Temp	Charpy Absorbed Energy Averag(3)
	3mm ≦ t ≦ 50mm	50mm < t ≦ 100mm	100mm < t ≦ 125mm	125mm < t ≦ 200mm	3mm ≦ t ≦ 50mm	50mm < t ≦ 100mm	100mm < t ≦ 125mm	125mm < t ≦ 200mm	L_0= 5.65S_0		
S690QL	690 min.	650 min.	630 min.		770 ~940	760 ~930	710~900		15% min.	-40℃	30J min.
S890QL	890 min.	830 min.		-	940 ~1100	880~1100		-	11% min.	-40℃	30J min.

Remark：1. For plate, strip and wide flats with widths ≥ 600mm, the direction transverse to the rolling direction applies. For all other products, the values apply for the direction parallel to the rolling direction.

2. Test piece is V-notch, and direction parallel to rolling direction. Another temperature (0℃ /50J min. or -20℃ /40J min.) may be agreed upon at the time of the order.

3. Using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.

6.1.8.4 ASTM A709-21 GR.HPS 70W (Hihg-performance and Atmospheric-corrosion-resistance Structural Steel for Bridges)

Grade	Thickness (t) mm	Chemical Compositions %												Tension Test			
		C	Si	Mn	P	S	Ni	Cr	Cu	V	Mo	Al	N	Yield Point or Yield Strength ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Elongation(2)	
																Test Piece in.(mm)	%
Grade HPS 70W(1)	t ≦ 63.50	0.11 max.	0.30 ~0.50	1.10 ~1.35	0.020 max.	0.006 max.	0.25 ~0.40	0.45 ~0.70	0.25 ~0.40	0.04 ~0.08	0.02 ~0.08	0.010 ~0.040	0.015 max.	70(485) min.	85~110 (585~760)	GL=2 (50)	19 min.
	63.50 < t ≦ 101.6			1.10 ~1.50													

Remark：1. The steel shall be calcium treated for sulfide shape control.

2. For plates wider than 24 in.(600mm), the elongation requirement is reduced 2%. When the thickness is less than 5/16 in.(8mm), see specification ASTM A6 for elongation adjustment.

3. Supplementary requirements: (Supplementary requirements shall not apply unless specified in the purchase order or contact)

Structural products ordered for use as critical member shall be impact tested in accordance with ASTM A673. Guidance is as follows:

(1) Fracture critical member shall specify Grade HPS 70WF, the CNV-impact testing shall be at P frequency in accordance with ASTM A673.

(2) Non-fracture critical member shall specify Grade HPS 70WT, the CNV-impact testing shall be at H frequency in accordance with ASTM A673.

(3) Test temperature for Zone 1、Zone 2 and Zone 3 are all -10˚F(-23℃).

Grade		Thickness (t) mm	Impact Test				
			Test Temp			Charpy Absorbed Energy ft · lbf (J)	
			Zone 1	Zone 2	Zone 3	Average	Individual
Grade HPS 70W	T	t ≦ 101.6	-10˚F (-23℃)	-10˚F (-23℃)	-10˚F (-23℃)	25 (34) min.	17 (23) min.
	F	t ≦ 101.6	-10˚F (-23℃)	-10˚F (-23℃)	-10˚F (-23℃)	35 (48) min.	28 (38) min.

Note：Test piece is V-notch, and direction parallel to rolling direction. Using test pieces of width less than 10mm, the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.

6.1.8.5 CNS 15504-24、JIS G3140-23 SBHS400 (Higher Yield Strength Steel Plates for Bridges)

Thickness (t) mm	Chemical Compositions %							Mechanical Properties							
	C	Si	Mn	P	S	N	Pcm(1)	Yield Point or Yield Strength (N/mm²)	Tensile Strength (N/mm²)	Elongation %			Impact Test(2)		
										No.1A	No.1A	No.4	Test Temp	Charpy Absorbed Energy Averag	Test Piece
										Thickness (t) mm					
										6 ≦ t ≦ 16	16 < t ≦ 50	40 < t ≦ 100			
6.00 ≦ t ≦ 100.0	0.15 max.	0.55 max.	2.00 max.	0.020 max.	0.006 max.	0.006 max.	0.22 max.	400 min.	490 ~640	15 min.	19 min.	21 min.	0℃	100J min.	V-notch, perpendicular to rolling direction

Remark：1. Pcm(%)= C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B.

2. Impact test is applicable to thickness over 12.0mm of steel.

6.1.8.6 ASTM A514-18 Higher-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

Grade	Thickness (t) mm	Chemical Compositions %										
		C	Si	Mn	P	S	Cr	Mo	V	Ti	B	Nb
Grade B	6.00 ≦ t ≦ 31.75	0.12~ 0.21	0.20~ 0.35	0.70~ 1.00	0.030 max.	0.030 max.	0.40~ 0.65	0.15~ 0.25	0.03~ 0.08	0.01~ 0.10	0.0005~ 0.0050	-
Grade S	6.00 ≦ t ≦ 63.50	0.11~ 0.21	0.15~ 0.45	1.10~ 1.50	0.030 max.	0.020 max.	-	0.10~ 0.60	0.06 max.	0.06 max.	0.0010~ 0.0050	0.06 max.

Grade	Thickness (t) mm	Mechanical Properties					
		Tension Test[1]					
		Yield Strength ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Elongation[2] [3]		Reduction of Area[2]%	
				Test Piece in.(mm)	%	Flat specimen	Round specimen
Grade B	6.00 ≦ t ≦ 19.05	100(690) min.	110~130 (760~895)	GL=2(50)	18 min.	40 min.	-
	19.05 < t ≦ 31.75					40 min.	50 min.
Grade S	6.00 ≦ t ≦ 19.05	100(690) min.	110~130 (760~895)	GL=2(50)	18 min.	40 min.	-
	19.05 < t ≦ 63.50					40 min.	50 min.

Remark：1. One tension test shall be taken from a corner of each plate as heat treated.
2. For plates tested in the transverse direction, the elongation requirement is reduced by 2% and the reduction of area minimum requirement is reduced by 5%.
3. When the thickness is less than 5/16 in.(8mm), see specification ASTM A6 for elongation adjustment.

6.1.8.7 CSC PZ780T (Rolled Steels for Welded Structure, Tenslie strength 780N/mm² min.)

Thickness (t) mm	Chemical Compositions %							Mechanical Properties					
								Tension Test				Impact Test		
	C	Si	Mn	P	S	Al	Ceq	Yield Strength (N/mm²)	Tenslie Strength (N/mm²)	Elongation		Test Temp	Charpy Absorbed Energy Averag	Test Piece
										No.1A	No.4			
										Thickness (t) mm				
										t ≦ 20	20 < t			
12.00 ≦ t ≦ 50.80	0.20 max.	0.80 max.	1.70 max.	0.025 max.	0.015 max.	0.020 max.	0.65 max.	685 min.	780 ~930	Only reference		-5℃	47J min.	No.4, Parallel to rolling direction

Remark：Ceq(%)= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

6.1.8.8 ASTM A537-20 CL.2 (Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel)

Grade	Thickness (t) mm	Chemical Compositions %									Tension Test			
		C	Si	Mn[1]	P	S	Cu	Ni[1]	Cr	Mo	Yield Strength ksi(N/mm²)	Tensile Strength ksi(N/mm²)	Elongation[2]	
													Test Piece in.(mm)	%
Class 2[3]	6.00 ≦ t ≦ 38.10	0.24 max.	0.15 ~0.50	0.70 ~1.35	0.025 max.	0.025 max.	0.35 max.	0.25 max.	0.25 max.	0.08 max.	60(415) min.	80~100 (550~690)	GL=2(50)	22 min.
	38.10 < t ≦ 63.50			1.00 ~1.60										

Remark：1. When the thickness is 1.50 in.(38.1mm) and under, manganese may exceed 1.35%, up to a maximum of 1.60%, and nickel may exceed 0.25%, 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+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15.
2. When the thickness is less than 5/16 in.(8mm), see specification ASTM A20 for elongation adjustment.
3. Class 2 (All thickness) plates shall be quenched and tempered.

6.2 Dimensional Tolerances

6.2.1 JIS G3193 Thickness Tolerances of Steel Plates

unit : mm

Thickness(t) \ Width(w)	800 ≦ w < 1600	1600 ≦ w < 2000	2000 ≦ w < 2500	2500 ≦ w < 3150	3150 ≦ w < 4000
6.00 ≦ t < 6.30	± 0.50	± 0.60	± 0.60	± 0.75	± 0.75
6.30 ≦ t < 10.0	± 0.55	± 0.65	± 0.65	± 0.80	± 0.80
10.0 ≦ t < 16.0	± 0.55	± 0.65	± 0.65	± 0.80	± 0.80
16.0 ≦ t < 25.0	± 0.65	± 0.75	± 0.75	± 0.95	± 0.95
25.0 ≦ t < 40.0	± 0.70	± 0.80	± 0.80	± 1.00	± 1.00
40.0 ≦ t < 63.0	± 0.80	± 0.95	± 0.95	± 1.10	± 1.10
63.0 ≦ t < 100	± 0.90	± 1.10	± 1.10	± 1.30	± 1.30
100 ≦ t ≦ 125	± 1.30	± 1.50	± 1.50	± 1.70	± 1.70

Remark : 1. When required, the tolerance in the above table may be one-sided either minus or plus side, provided that the total range of the tolerance in this case shall be equal to the total range of the tolerance given in the above table.

2. The positions where the thickness is to be measured shall be as follows:

(1) For as-rolled steel plates with edge untrimmed, any point inward from the line of width predetermined to be cut.

(2) For cut-edged steel plates, any point 15.00mm and over inward from the edge.

3. The above table does not apply to the pressure vessel plates.

6.2.2 JIS G3136 (SN Steel) Thickness Tolerances of Steel Plates

unit : mm

Thickness(t) \ Width(w)	800 ≦ w < 1600	1600 ≦ w < 2000	2000 ≦ w < 2500	2500 ≦ w < 3150	3150 ≦ w < 4000
6.00 ≦ t < 6.30	+ 0.70	+ 0.90	+ 0.90	+ 1.20	+ 1.20
6.30 ≦ t < 10.0	+ 0.80	+ 1.00	+ 1.00	+ 1.30	+ 1.30
10.0 ≦ t < 16.0	+ 0.80	+ 1.00	+ 1.00	+ 1.30	+ 1.30
16.0 ≦ t < 25.0	+ 1.00	+ 1.20	+ 1.20	+ 1.60	+ 1.60
25.0 ≦ t < 40.0	+ 1.10	+ 1.30	+ 1.30	+ 1.70	+ 1.70
40.0 ≦ t < 63.0	+ 1.30	+ 1.60	+1.60	+ 1.90	+ 1.90
63.0 ≦ t < 100	+ 1.50	+ 1.90	+ 1.90	+ 2.30	+ 2.30
100	+ 2.30	+ 2.70	+ 2.70	+ 3.10	+ 3.10

Remark : 1. The minus side of thickness tolerance shall be -0.30mm.

2. The positions where the thickness is to be measured shall be as follows:

(1) For as-rolled steel plates with edge untrimmed, any point inward from the line of width predetermined to be cut.

(2) For cut-edged steel plates, any point 15.00mm and over inward from the edge.

6.2.3 JIS G3103 (SB Steel)、JIS G3115 (SPV Steel) Thickness Tolerances of Steel Plates

unit：mm

Thickness(t) \ Width(w)	800 ≦ w < 1600	1600 ≦ w < 2000	2000 ≦ w < 2500	2500 ≦ w < 3150	3150 ≦ w < 4000
6.00 ≦ t < 6.30	+ 0.75	+ 0.95	+ 0.95	+ 1.25	+ 1.25
6.30 ≦ t < 10.0	+ 0.85	+ 1.05	+ 1.05	+ 1.35	+ 1.35
10.0 ≦ t < 16.0	+ 0.85	+ 1.05	+ 1.05	+ 1.35	+ 1.35
16.0 ≦ t < 25.0	+ 1.05	+ 1.25	+ 1.25	+ 1.65	+ 1.65
25.0 ≦ t < 40.0	+ 1.15	+ 1.35	+ 1.35	+ 1.75	+ 1.75
40.0 ≦ t < 63.0	+ 1.35	+ 1.65	+ 1.65	+ 1.95	+ 1.95
63.0 ≦ t < 100	+ 1.55	+ 1.95	+ 1.95	+ 2.35	+ 2.35

Remark：The minus side tolerance on thickness shall be -0.25mm.

6.2.4 ASTM A6、ASME SA6 Thickness Tolerances of Steel Plates

unit：mm

Thickness(t) \ Width(w)	800 ≦ w < 1219	1219 ≦ w < 1524	1524 ≦ w < 1829	1829 ≦ w < 2134	2134 ≦ w < 2438	2438 ≦ w < 2743	2743 ≦ w < 3048	3048 ≦ w < 3353	3353 ≦ w < 3658	3658 ≦ w < 4267
6.00 ≦ t < 6.35	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	1.02	–
6.35 ≦ t < 7.94	0.76	0.76	0.76	0.76	0.76	0.76	0.76	1.02	1.02	–
7.94 ≦ t < 9.53	0.76	0.76	0.76	0.76	0.76	0.76	0.76	1.02	1.02	1.27
9.53 ≦ t < 11.11	0.76	0.76	0.76	0.76	0.76	0.76	1.02	1.02	1.27	1.52
11.11 ≦ t < 12.70	0.76	0.76	0.76	0.76	0.76	0.76	1.02	1.02	1.27	1.52
12.70 ≦ t < 15.88	0.76	0.76	0.76	0.76	0.76	0.76	1.02	1.02	1.27	1.52
15.88 ≦ t < 19.05	0.76	0.76	0.76	0.76	0.76	1.02	1.02	1.02	1.27	1.52
19.05 ≦ t < 25.40	0.76	0.76	0.76	0.76	1.02	1.02	1.27	1.27	1.52	1.78
25.40 ≦ t < 50.80	1.52	1.52	1.52	1.52	1.52	1.78	2.03	2.54	2.54	2.79
50.80 ≦ t < 76.20	2.29	2.29	2.29	2.54	2.54	2.79	3.05	3.30	3.56	3.81
76.20 ≦ t < 101.60	2.79	2.79	2.79	2.79	2.79	3.30	3.56	3.56	3.56	3.81
101.60 ≦ t < 125.00	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	5.08

Remark：1. The minus side tolerance on thickness shall be -0.25mm.

2. Thickness shall be measured at 9.53 to 19.05mm from the longitudinal edge.

3. For thickness measured at any location other than that specified in remark 2, the permissible maximum over tolerance shall be increased by 75%.

6.2.5 EN 10029 Thickness Tolerances of Steel Plates

unit : mm

Thickness(t)	Tolerance			
	Class A	Class B	Class C	Class D
6.00 ≦ t < 8.00	-0.4~+0.8	-0.3~+0.9	0~+1.2	-0.6~+0.6
8.00 ≦ t < 15.0	-0.5~+0.9	-0.3~+1.1	0~+1.4	-0.7~+0.7
15.0 ≦ t < 25.0	-0.6~+1.0	-0.3~+1.3	0~+1.6	-0.8~+0.8
25.0 ≦ t < 40.0	-0.7~+1.3	-0.3~+1.7	0~+2.0	-1.0~+1.0
40.0 ≦ t < 80.0	-0.9~+1.7	-0.3~+2.3	0~+2.6	-1.3~+1.3
80.0 ≦ t < 150.0	-1.1~+2.1	-0.3~+2.9	0~+3.2	-1.6~+1.6
150.0 ≦ t < 250.0	-1.2~+2.4	-0.3~+3.3	0~+3.6	-1.8~+1.8
250.0 ≦ t < 400.0	-1.3~+3.5	-0.3~+4.5	0~+4.8	-2.4~+2.4

Remark : At the time of enquiry and order, the purchaser shall indicate if class A, B,C or D tolerances is required. If no class is stated, class A applies.

6.2.6 CR Thickness Tolerances of Steel Plates

unit : mm

Norminal Thickness(t)	Measurment		Tolerance			
			Single point		Average	
	Method	Position	Lower	Upper	Lower	Upper
6.00 ≦ t ≦ 75.00	Remark(1)	Remark(2)(3)	-0.3	In accordancr with International Standard (ex:ISO,JIS,ASTM etc.)	0.0	In accordancr with International Standard (ex:ISO,JIS,ASTM etc.)

Remark : 1. An automated method or manual method may be applied to the thickness measurements.
2. For automated methods, the measuring points at sides are to be located not less than 10mm, but not greater than 300mm from the transverse or longitudinal edges of the product.
3. For manual methods, the measuring points at sides are to be located not less than 10mm, but not greater than 100mm from the transverse or longitudinal edges of the product.

6.2.7 JIS G3193 Width Tolerances of Steel Plates

unit : mm

Width(w)	Thickness(t)	Tolerance			
		Mill Edge		Cut Edge (By Ordinary Cutting)	
		Lower	Upper	Lower	Upper
1000 ≦ w < 1250	6.00 ≦ t < 20.00	0	Not specified	0	15
	20.00 ≦ t				15
1250 ≦ w < 1600	6.00 ≦ t < 20.00	0	Not specified	0	15
	20.00 ≦ t				15
1600 ≦ w < 2000	6.00 ≦ t < 20.00	0	Not specified	0	20
	20.00 ≦ t				20
2000 ≦ w < 3000	6.00 ≦ t < 20.00	0	Not specified	0	20
	20.00 ≦ t				20
3000 ≦ w	6.00 ≦ t < 20.00	0	Not specified	0	25
	20.00 ≦ t				25

6.2.8 JIS G3193 Length Tolerances of Steel Plates

unit：mm

Length(L)	Tolerance	
	Cut Edge (By Ordinary Cutting)	
	Lower	Upper
3048 ≦ L < 4000	0	20
4000 ≦ L < 6000	0	30
6000 ≦ L < 8000	0	40
8000 ≦ L < 10000	0	50
10000 ≦ L < 15000	0	75
15000 ≦ L < 18500	0	100

6.2.9 ASTM Length & Width Tolerances of Sheared Plates

unit：mm

Specified Dimensions		Upper Limit of Tolerance on Length & Width for Thickness (t)							
Length(L)	Width(w)	t ≦ 9.52		9.53 ≦ t ≦ 15.88		15.89 ≦ t ≦ 25.39		25.40 ≦ t ≦ 50.80	
		Width	Length	Width	Length	Width	Length	Width	Length
L < 3048	w < 1524	9	13	11	16	13	19	16	25
	1524 ≦ w < 2133	11	16	13	17	16	22	19	25
	2133 ≦ w < 2743	13	19	16	22	19	25	25	28
	2743 ≦ w	16	22	19	25	22	28	28	32
3048 ≦ L < 6096	w < 1524	9	19	13	22	16	25	19	28
	1524 ≦ w < 2133	13	19	16	22	19	25	22	32
	2133 ≦ w < 2743	14	22	17	24	20	28	25	35
	2743 ≦ w	16	25	19	28	22	32	28	35
6096 ≦ L < 9144	w < 1524	9	25	13	28	16	32	19	38
	1524 ≦ w < 2133	13	25	16	28	19	32	22	38
	2133 ≦ w < 2743	14	25	17	28	22	35	25	38
	2743 ≦ w	17	28	22	32	25	35	32	44
9144 ≦ L < 12192	w < 1524	11	28	13	32	16	35	19	41
	1524 ≦ w < 2133	13	32	16	35	19	38	22	41
	2133 ≦ w < 2743	14	32	19	35	22	38	25	47
	2743 ≦ w	19	35	22	38	25	41	32	47
12192 ≦ L < 15240	w < 1524	11	32	13	38	16	41	19	47
	1524 ≦ w < 2133	13	35	16	38	19	41	22	47
	2133 ≦ w < 2743	16	35	19	38	22	41	25	47
	2743 ≦ w	19	38	22	41	25	44	32	47
15240 ≦ L < 18288	w < 1524	13	44	16	47	19	47	22	57
	1524 ≦ w < 2133	16	44	19	47	22	47	25	57
	2133 ≦ w < 2743	16	44	19	47	22	47	28	57
	2743 ≦ w	22	44	25	51	28	57	32	63
18288 ≦ L	w < 1524	14	51	19	54	22	57	25	70
	1524 ≦ w < 2133	19	51	22	54	25	57	28	70
	2133 ≦ w < 2743	19	51	22	54	25	57	32	70
	2743 ≦ w	25	51	28	60	32	63	35	76

Remark：The lower limit tolerance on specified length and width is -6mm.

6.2.10 ASTM Width & Length Tolerances of Steel Plates

unit：mm

Specified Thickness (t)	Tolerance on Width and length (Applies to Carbon Steel)	Tolerance on Width and length (Applies to Alloy Steel)
t < 50.8	+ 13 − 0	+ 19 − 0
50.8 ≦ t < 101.6	+ 16 − 0	+ 25 − 0
101.6 ≦ t ≦ 125.0	+ 19 − 0	+ 28 − 0

6.2.11 EN 10029 Width Tolerances of Steel Plates

unit：mm

Nominal Thickness (t)	Tolerance	
	Lower	Upper
t < 40.0	0	+ 20
40.0 ≦ t < 150.0	0	+ 25
150.0 ≦ t ≦ 400.0	0	+ 30

6.2.12 EN 10029 Lenght Tolerances of Steel Plates

unit：mm

Nominal Length (L)	Tolerance	
	Lower	Upper
L < 4000	0	+ 20
4000 ≦ L < 6000	0	+ 30
6000 ≦ L < 8000	0	+ 40
8000 ≦ L < 10000	0	+ 50
10000 ≦ L < 15000	0	+ 75
15000 ≦ L ≦ 20000	0	+ 100

6.2.13 JIS G3193 Flatness Tolerances of Steel Plates[1]

unit : mm

Measured Length[2]	2000				4000		
Width(w) / Thickness(t)	800 ≦ w < 1250	1250 ≦ w < 1600	1600 ≦ w < 2000	2000 ≦ w	800 ≦ w < 2000	2000 ≦ w < 3000	3000 ≦ w
6.00 ≦ t < 8.00	13	13	13	21	22	28	– [3]
8.00 ≦ t < 15.00	12	12	12	16	12	16	24
15.00 ≦ t < 25.00	12	12	12	16	12	16	22
25.00 ≦ t < 40.00	9	9	9	13	9	13	19
40.00 ≦ t < 80.00	8	8	8	11	8	11	16
80.00 ≦ t < 150.0	8	8	8	10	8	10	15
150.0 ≦ t < 250.0	10	10	10	15	10	15	20
250.0 ≦ t < 350.0	20	20	20	20	20	20	20
350.0 ≦ t	25	25	25	25	25	25	25

Measurement of flatness, as a rule, shall be made on a flat surface plate. The deviation from the flatness shall be determined as the difference between the maximum deviation of convex side uppermost from the flat surface and thickness of the steel plate and sheet themselves. For th steel plate and sheet as-rolled (with untrimmed edge), it may be upon the agreement between the purchaser and the supplier.

Remark : 1. Unless otherwise specified, 1.5 times the maximum deviation from flatness specified in this table shall be applied to the steel plate and sheet of which the lower limit of yield point or proof strength in tensile test is at least 460N/mm^2, or chemical composition or hardness is equivalent thereto, or quenched and tempered.

2. Values in this table shall be applied to any 2000mm length. For the steel plate and sheet under 2000mm in length, the values shall be applied to the full length. For the steel plate and sheet over 2000mm in wave pitch, the values in this table shall be applied to any pitch of the wave. For those over 4000mm in wave pitch, however, the above values shall applied to any 4000mm length.

3. Values agreed between the purchaser and the supplier.

6.2.14 EN 10029 Flatness Tolerances of Steel Plates

unit : mm

Nominal Thickness (t)	Normal Tolerance (Class N)				Special Tolerance (Class S)			
	Type L		Type H		Type L		Type H	
	Measured Length				Measured Length			
	1000	2000	1000	2000	1000	2000	1000	2000
6.00 ≦ t < 8.00	8	12	11	15	5	10	7	13
8.00 ≦ t < 15.00	7	11	10	14	3	6	7	12
15.00 ≦ t < 25.00	7	10	10	13	3	6	7	11
25.00 ≦ t < 40.00	6	9	9	12	3	6	7	11
40.00 ≦ t < 250.0	5	8	8	12	3	6	6	10
250.0 ≦ t ≦ 400.0	6	9	9	13	4	7	7	11

Remark : 1. The plate shall be supplied with normal tolerances (Class N), only if otherwise specified in the order the plate shall be supplied with special tolerances (Class S).

2. Type L: Products with a specified minimum yield strength ≦ 460MPa, neither quenched nor quenched and tempered.

3. Type H: Products with a specified yield strength > 460MPa and all grades of quenched and quenched and tempered products.

6.2.15 ASTM Flatness Tolerances of Steel Plates (Applies to Carbon Steel Only)

unit：mm

Specified Thickness (t)	Permitted Variations From a Flat Surface for Specified Width (w)										
	w < 914	914 ≦ w < 1219	1219 ≦ w < 1524	1524 ≦ w < 1829	1829 ≦ w < 2134	2134 ≦ w < 2438	2438 ≦ w < 2743	2743 ≦ w < 3048	3048 ≦ w < 3658	3658 ≦ w < 4267	4267 ≦ w
t < 6.35	14	19	24	32	35	38	41	44	48	–	–
6.35 ≦ t < 9.53	13	16	19	24	29	32	35	38	41	–	–
9.53 ≦ t < 12.70	13	14	16	16	19	22	25	29	32	48	54
12.70 ≦ t < 19.05	11	13	14	16	16	19	25	25	29	38	51
19.05 ≦ t < 25.40	11	13	14	16	16	16	19	22	25	35	44
25.40 ≦ t < 50.80	10	13	13	14	14	16	16	16	18	29	38
50.80 ≦ t < 101.6	8	10	11	13	13	13	13	14	16	22	29
101.6 ≦ t < 125.0	10	11	13	13	14	14	16	19	22	22	25

Remark：1. The above table applies to flatness variations for length and width.

2. The flatness variations across the width shall not exceed the tabular amount for the specified width.
3. The permissible variations in flatness along the length shall not exceed the tabular amount for the specified width in plates up to 3.6m in length, or in any 3.6m of longer plates.
4. When the longer dimension is under 914mm, the permissible variation shall not exceed 6mm. When the longer dimension ranges from 914mm to 1829mm incl., the permissible variation shall not exceed 75% of the tabular amount for the specified width, but in no case less than 6mm.
5. These variations apply to plates which have a specified min. tensile strength not more than 60ksi(414N/mm^2) or comparable chemistry or hardness. The limits in the table are increased 50% for plates specified to a higher min. tensile strength.

6.2.16 ASTM Flatness Tolerances of High-Strength Low-Alloy and Alloy Steel Plates

unit：mm

Specified Thickness (t)	Flatness Tolerances for Specified Widths (w)										
	w < 914	914 ≦ w < 1219	1219 ≦ w < 1524	1524 ≦ w < 1829	1829 ≦ w < 2134	2134 ≦ w < 2438	2438 ≦ w < 2743	2743 ≦ w < 3048	3048 ≦ w < 3658	3658 ≦ w < 4267	4267 ≦ w
t < 6.35	21	29	35	47	51	57	60	67	70	–	-
6.35 ≦ t < 9.53	19	24	29	35	44	48	51	57	60	–	-
9.53 ≦ t < 12.70	19	22	24	24	29	33	38	41	48	70	79
12.70 ≦ t < 19.05	16	19	21	22	25	29	32	35	41	57	76
19.05 ≦ t < 25.40	16	19	22	22	24	25	29	33	38	51	67
25.40 ≦ t < 50.80	14	16	19	21	22	24	25	25	25	41	57
50.80 ≦ t < 101.6	13	14	18	19	19	19	19	22	25	32	41
101.6 ≦ t < 125.0	14	18	19	19	22	22	24	29	32	32	38

Remark：1. The above table applies to flatness variations for length and width.

2. The flatness variations across the width shall not exceed the tabular amount for the specified width.
3. The permissible variations in flatness along the length shall not exceed the tabular amount for the specified width in plates up to 3.6m in length, or in any 3.6m of longer plates.
4. When the longer dimension is under 914mm, the variation shall not exceed 9.5mm. When the longer dimension ranges from 914mm to 1829mm incl., the variation shall not exceed 75% of the tabular amount for the specified width.

6.2.17 JIS, ASTM and EN Maximum Camber Tolerance of Steel Plate

unit：mm

Standard	JIS G3193		ASTM A6	EN 10029
Length(L) / Width(w))	L < 10000	L ≧ 10000	Not Specified	Not Specified
w ≧ 1525	Length x 0.2% max.(1) (For the length of steel plates)	Length x 0.2% max.(1) (For 10000 of length at any position)	Length x 0.2% max.(2) (For the length of steel plates)	-

Remark：1. The above table is not applicable to the steel plate and sheet as rolled (with untrimmed edge).
2. The above table applies to shear-cut and flame-cut plates.

6.2.18 ASTM Permissible Variation in Waviness Tolerances for Plates

Flatness Tolerances (from 6.2.15 or 6.2.16), mm	Permitted Variations in Waviness, mm, When Number of Waves in 3600mm is						
	1	2	3	4	5	6	7
8	8	6	5	3	3	2	2
10	10	8	5	5	3	2	2
11	11	8	6	5	3	3	2
13	13	10	8	5	5	3	2
14	14	11	8	6	5	3	2
16	16	13	10	6	5	3	2
17	17	13	10	8	5	5	2
19	19	14	11	8	6	5	2
21	21	16	11	8	6	5	2
22	22	17	13	10	6	5	2
24	24	17	13	10	8	6	5
25	25	19	14	11	8	6	5
29	29	22	16	13	10	6	6
32	32	24	17	13	10	8	6
35	35	27	19	14	11	8	6
38	38	29	22	16	13	10	6
41	41	32	24	17	13	10	8
44	44	33	25	19	14	11	8
48	48	37	27	21	14	11	8
51	51	38	29	22	16	13	10
54	54	41	30	22	17	13	10
57	57	43	32	24	17	14	10
60	60	46	33	25	19	14	11
64	64	48	37	27	21	14	11
67	67	51	38	29	21	16	11
70	70	52	40	29	22	16	13
73	73	56	41	30	24	17	13
76	76	57	43	32	24	17	14
79	79	60	44	33	25	19	14

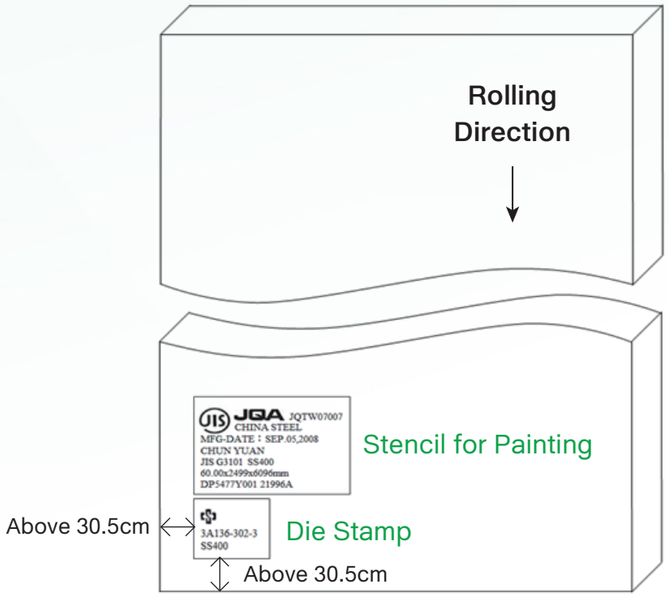
Remark：The waviness tolerance is a function of the flatness tolerance as obtained from 6.2.15 or 6.2.16.

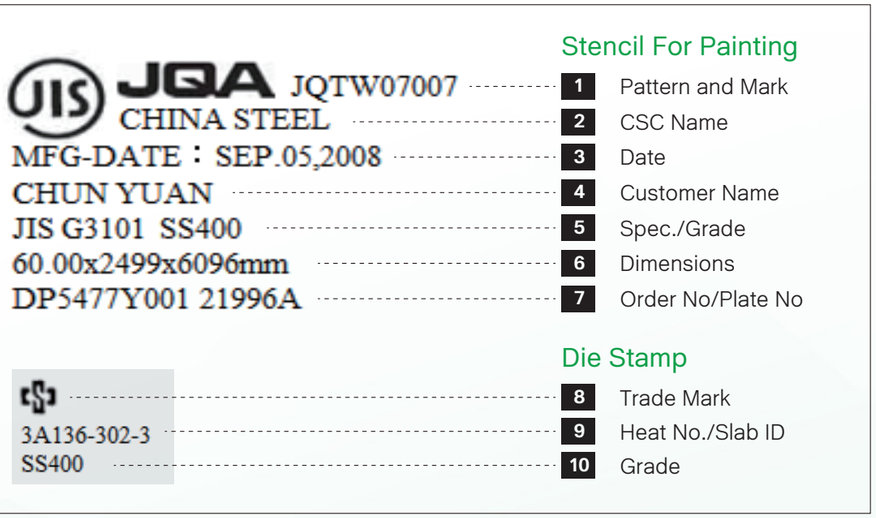
Unit : Thickness/Width: mm, Length: m

Width / Length / Thickness	1524 ~ 1599	1600 ~ 1700	1701 ~ 1800	1801 ~ 1900	1901 ~ 2050	2051 ~ 2200	2201 ~ 2400	2401 ~ 2600	2601 ~ 2800	2801 ~ 3000	3001 ~ 3200	3201 ~ 3400	3401 ~ 3600	3601 ~ 3800	Width / Length / Thickness
6.00 – 6.99													Negotiation		6.00 – 6.99
7.00 – 7.99															7.00 – 7.99
8.00 – 8.99															8.00 – 8.99
9.00 – 9.99															9.00 – 9.99
10.00 – 11.99															10.00 – 11.99
12.00 – 13.99															12.00 – 13.99
14.00 – 15.99															14.00 – 15.99
16.00 – 17.99															16.00 – 17.99
18.00 – 19.99															18.00 – 19.99
20.00 – 21.99															20.00 – 21.99
22.00 – 23.99														17.7	22.00 – 23.99
24.00 – 25.99													17.2	16.3	24.00 – 25.99
26.00 – 27.99												16.9	16.0	15.1	26.00 – 27.99
28.00 – 29.99											16.9	15.8	14.9	14.1	28.00 – 29.99
30.00 – 31.99										16.9	15.8	14.8	14.0	13.2	30.00 – 31.99
32.00 – 33.99									17.0	15.9	14.9	13.9	13.1	12.4	32.00 – 33.99
34.00 – 35.99									16.1	15.0	14.0	13.1	12.4	11.7	34.00 – 35.99
36.00 – 37.99								16.4	15.2	14.2	13.3	12.4	11.7	11.1	36.00 – 37.99
38.00 – 39.99								15.6	14.4	13.5	12.6	11.8	11.1	10.5	38.00 – 39.99
40.00 – 41.99							16.0	14.8	13.7	12.8	12.0	11.2	10.6	10.0	40.00 – 41.99
42.00 – 43.99							15.2	14.1	13.1	12.2	11.4	10.7	10.1	9.5	42.00 – 43.99
44.00 – 45.99							14.6	13.5	12.5	11.7	10.9	10.2	9.6	9.1	44.00 – 45.99
46.00 – 47.99							13.9	13.0	12.0	11.2	10.5	9.8	9.2	8.7	46.00 – 47.99
48.00 – 50.80							13.4	12.4	11.5	10.7	10.0	9.4	8.8	8.4	48.00 – 50.80
50.81 – 51.99							12.9	11.9	11.0	10.3	9.6	9.0	8.5	8.0	50.81 – 51.99
52.00 – 53.99							12.4	11.5	10.6	9.9	9.3	8.7	8.2	7.7	52.00 – 53.99
54.00 – 55.99							11.9	11.1	10.3	9.6	8.9	8.3	7.9	7.4	54.00 – 55.99
56.00 – 57.99							11.5	10.7	9.9	9.2	8.6	8.1	7.6	7.2	56.00 – 57.99
58.00 – 59.99							11.1	10.3	9.6	8.9	8.3	7.8	7.3	6.9	58.00 – 59.99
60.00 – 61.99							10.7	10.0	9.2	8.6	8.1	7.5	7.1	6.7	60.00 – 61.99
62.00 – 63.99							10.4	9.7	8.9	8.3	7.8	7.3	6.9	6.5	62.00 – 63.99
64.00 – 65.99							10.1	9.4	8.7	8.1	7.6	7.1	6.6	6.3	64.00 – 65.99
66.00 – 67.99							9.8	9.1	8.4	7.8	7.3	6.8	6.4	6.1	66.00 – 67.99
68.00 – 69.99							9.5	8.8	8.2	7.6	7.1	6.6	6.3	5.9	68.00 – 69.99
70.00 – 71.99							9.2	8.6	7.9	7.4	6.9	6.4	6.1	5.7	70.00 – 71.99
72.00 – 73.99							9.0	8.3	7.7	7.2	6.7	6.3	5.9	5.6	72.00 – 73.99
74.00 – 75.99							8.7	8.1	7.5	7.0	6.5	6.1	5.7	5.4	74.00 – 75.99
76.00 – 77.99							8.5	7.9	7.3	6.8	6.4	5.9	5.6	5.3	76.00 – 77.99
78.00 – 79.99							8.3	7.7	7.1	6.6	6.2	5.8	5.4	5.1	78.00 – 79.99
80.00 – 81.99							8.1	7.5	6.9	6.5	6.0	5.6	5.3	5.0	80.00 – 81.99
82.00 – 83.99							7.9	7.3	6.8	6.3	5.9	5.5	5.2	4.9	82.00 – 83.99
84.00 – 85.00							7.8	7.2	6.7	6.2	5.8	5.4	5.1	4.8	84.00 – 85.00
85.01 – 90.00							7.3	6.8	6.3	5.9	5.5	5.1	4.8	4.6	85.01 – 90.00
90.01 – 95.00							6.9	6.4	6.0	5.5	5.2	4.8	4.6		90.01 – 95.00
95.01 – 100.00							6.6	6.1	5.6	5.3	4.9	4.6			95.01 – 100.00
100.01 – 105.00							6.3	5.8	5.4	5.0	4.7				100.01 – 105.00
105.01 – 110.00							6.0	5.5	5.1	4.8					105.01 – 110.00
110.01 – 115.00							5.7	5.3	4.9						110.01 – 115.00
115.01 – 120.00							5.5	5.1	4.7						115.01 – 120.00
120.01 – 125.00							5.2	4.8	4.5						120.01 – 125.00
Thickness / Length / Width	1524 ~ 1599	1600 ~ 1700	1701 ~ 1800	1801 ~ 1900	1901 ~ 2050	2051 ~ 2200	2201 ~ 2400	2401 ~ 2600	2601 ~ 2800	2801 ~ 3000	3001 ~ 3200	3201 ~ 3400	3401 ~ 3600	3601 ~ 3800	Thickness / Length / Width

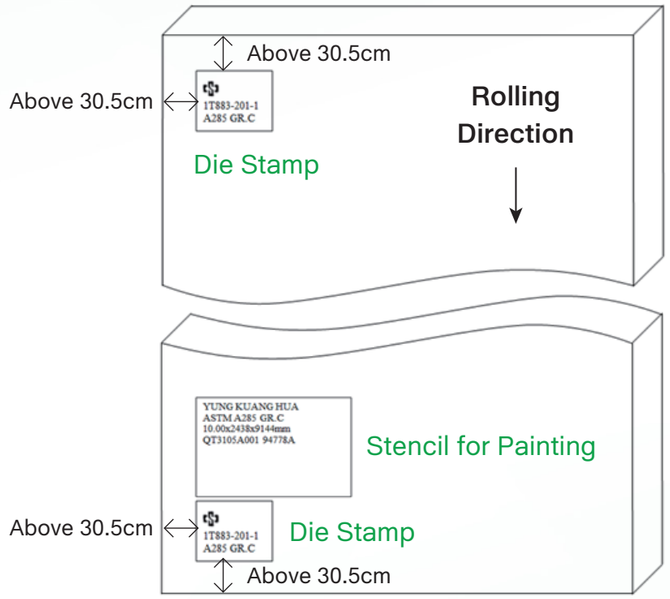
Maximum length for this area: 18.5m

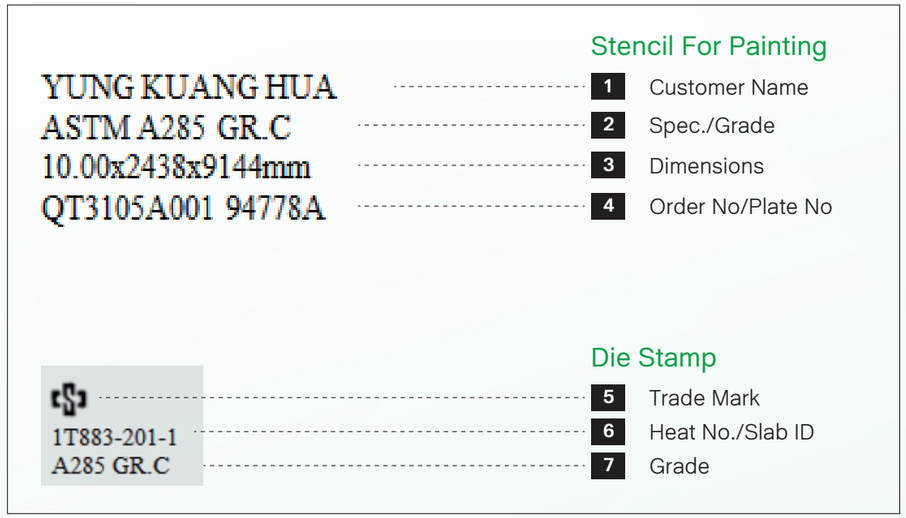
8.1 Plate for general use





8.2 Plate for Pressure Vessel





9.1 Orientation Feature

Plate products are produced from slabs through rolling process. In general, the properties of plate on rolling direction (longitudinal) are better than those on transverse direction. In addition, the applications, which stress is applied on thickness direction and the effect of middle thickness position of plate due to the center segregation of slabs, shall be considered. The properties on thickness direction shall be also asked to announce and verify if necessary.

9.2 Post-Processes and Quality Requirements

The ways of processing for plate products are mostly often seen in cutting, bending and welding, among which welding is specially the most major way of processing since almost all applications of steel plates need to have the post-process for welding. The use of steel plates, in addition to the requirements for specification tolerance and surface quality, the inner quality for satisfying various uses needs to have the corresponding quality properties, such as strength, toughness, corrosion resistance, weldability etc. Therefore, it should plan carefully in the early stage of material design according to the end-uses and consider the subsequent corresponding processes to avoid unexpected failures.

9.3 The Influences of Cutting

Since shear-cutting produces some unfavorable features such as micro cracks, burrs and hardened layer on the cutting surface, it is easy to result in the end-surface cracks that are detrimental to following processes. The effective methods to prevent the occurring of end-surface cracks are removing of burrs, making of rounded corners or heat annealing.

Flame-cutting will harden the cutting surface by the quenching effect which is positively correlative to the carbon equivalent. Mild heating to the cutting region before and after flame-cutting is helpful to the subsequent processes.

9.4 Weldability

Welding area includes fusion zone (i.e. the weld metal) and heat affected zone (HAZ). The fusion zone forms casting texture while the HAZ turns to a hardened area after welding. Due to quenching effect, HAZ is characterized by its low elongation and could be a crack source during welding or using. Hence, the material properties and welding conditions have to be confirmed so that the highest hardness in heat affected zone can be possibly reduced. Since the highest hardness is generally a direct proportion with the carbon content, the hardened area alloy additions (as carbon equivalent) can be considered and adjusted from the early stage of material design in order to improve the weldability and reduce the detrimental effects of HAZ.

The carbon equivalent Ceq(%)	C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15

Steel grades that contains Ni, Cr, Mo, Cu, V and Nb in the composition need to be treated carefully during welding because the material is easy to form a HAZ with very hard textures and result in such problems as low elongation and low-temperature cracks.

Low-temperature crack happens after a period of time from the welding, including underbead crack, root crack and toe crack, etc. The causes of low-temperature crack include the elongation of HAZ, the diffusion of hydrogen in weld metal, and the restraint and hardenability of material.

Pcm, the low-temperature crack sensitivity, is a quantitative index to monitor the correlation between chemical composition and low-temperature crack occurrence, which can be calculated as below:

Pcm(%)	C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B

The lower Pcm value, the lower risk of crack of materials is. It may reduce preheating temperature when doing the welding. Pcm is a very important property to the steel maker developing high strength steels, and it have to be properly handled for the production of steels with excellent weldability and crack resistance.

9.5 Bendability

The bending radius applied on a steel plate shall not be smaller than the minimum value given by specification. The degree of minimum bending radius depends on the thickness and materials of steel plates. The smaller minimum bending radius, the better bendability of steel plates is. As for the influences of thickness of steel plates, the thicker, the more difficult processing is, and the larger minimum bending radius becomes, too.

Because the effect of rolling steel plates with longitudinal direction for bending work is better than that with the transverse direction, when the bending direction is toward parallel direction of rolling, the materials can bear more strains. In reverse, it is easy to crack if the bending direction is vertical direction of rolling. These factors should be regarded at sampling and planning stage for preventing bending work from cracks. Furthermore, burrs of cutting surface are supposed to be in the inner radius of bending since they are crack inducers under tension stress.

9.6 Ultrasonic Test

(1) Since CSC uses continuous casting slabs to roll steel plates, the maximum thickness of slabs is 270 mm. The maximum thickness of plate would be extended as possible to meet requirments of customers. And for the rolling ratio and safty considerations, customers should consider doing the UT examination.

(2) Adoptable ultrasonic test standards are listed as follows:

(a) ASTM A435 and A578 : The ultrasonic tests that focus on inner layer type defect detection. Test and acceptance criteria of A578 are divided into 3 levels of A, B and C. Level A is the same with A435 that single defective spot shall not be larger than 3 inches or the circle area of the diameter of 1/2 thickness. Level B is altered from level A that nearby small defects will be involved into the calculation of defect size. Level C is the strictest that the acceptable single maximum defect size shall not be larger than 1 inch.

(b) JIS G0801 and G0901: G0801 is designed for pressure vessels and is divided into 3 types of A, B and C. G0901 is designed for building structures and is divided into 2 types of X and Y. Both standards focus on the detection of inner layers and defect spots that the criteria of G0801 are stricter than that of G0901.

Length			
ft	in	mm	m
1	12	304.8	0.3048
0.08333	1	25.4	0.0254
0.003281	0.03937	1	0.001

Mass	Force
1kg=2.20462 lb	1kgf=9.80665 N

Stress			
ksi (= 1000psi)	psi	kgf/mm^2	N/mm^2 (= MPa)
1	1000	0.703070	6.89476
0.001	1	7.03070×10^{-4}	6.89476×10^{-3}
1.42233	1422.33	1	9.80665
0.145038	145.038	0.101972	1

Absorbed Energy		
ft-lbf	kgf-m	N-m (= joule)
1	0.138255	1.35582
7.23301	1	9.80665
0.737562	0.101972	1

Required Ordering Data		Example
1	Specification	ASTM/ASME/JIS
2	Designation Grade and Year of Issue	A36/SA36/SS400
3	Order Size (Thickness × Width × Length)	6.00~125mm × 1524mm × 3048mm
4	Order Piece	7 pieces
5	Chemical Composition	Specification/Cust.Spec./Mill Range
6	Application	General Purpose
7	Edge Status	Mill Edge or Cut Edge
8	Delivery Condition	As-Rolled/Normalized/Control Rolled
9	Special Requirements (If required)	Ultrasonic Test (A435/A578/G0801/G0901)
		Impact Test (Temp./Direction/Absorption Energy)
		Simulated Post Welding Heat Treatment (Hold Temp./Time/Heating or Cooling Rate)

1. The contents of this catalog are for reference only. Customers are urged to consult the specifications published by the corresponding Associations.
2. Information on the available steel grades, size, marking and packing as shown herein may be updated without notice to comply with actual production situations.
3. We invite you to contact our Head Office should you have any questions concerning steel specifications or ordering requirements.

Phone numbers are listed below for your convenience. Numbers of our international offices are shown on the back cover.

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Fax	886-7-3356411
E-mail	c00681@mail.csc.com.tw

CSGT (SHANGHAI) CO., LTD.	
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Tel	86-21-62896898
Fax	86-21-62896678
E-mail	c00392@csgtsha.com

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E-mail	changcc@csgtsg.com.sg

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