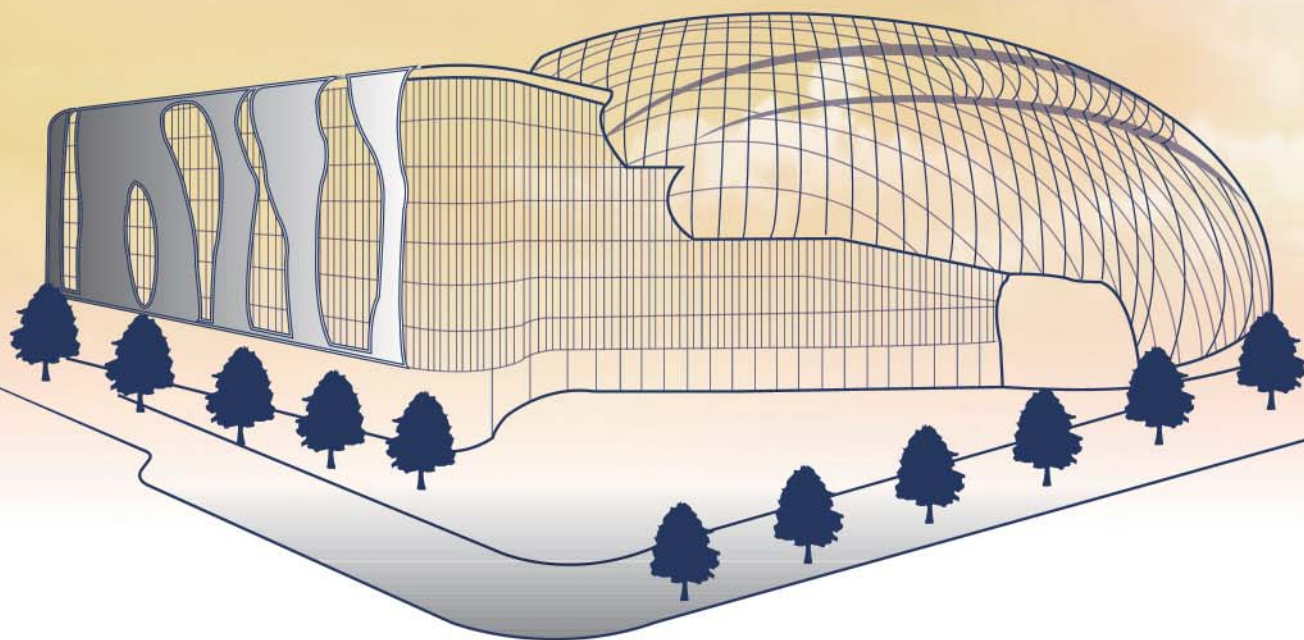
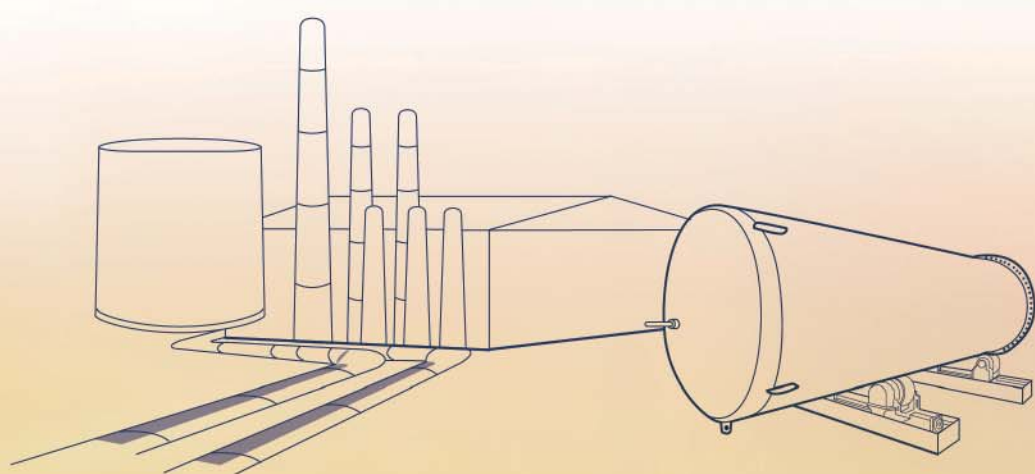


Titanium Alloys & Nickel-Based Alloys



PRODUCT MANUAL

鈦合金及鎳基合金



CHINA STEEL

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.



China Steel Building (Group Headquarters)



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A NAME FOR QUALITY,
TECHNOLOGY AND SERVICE

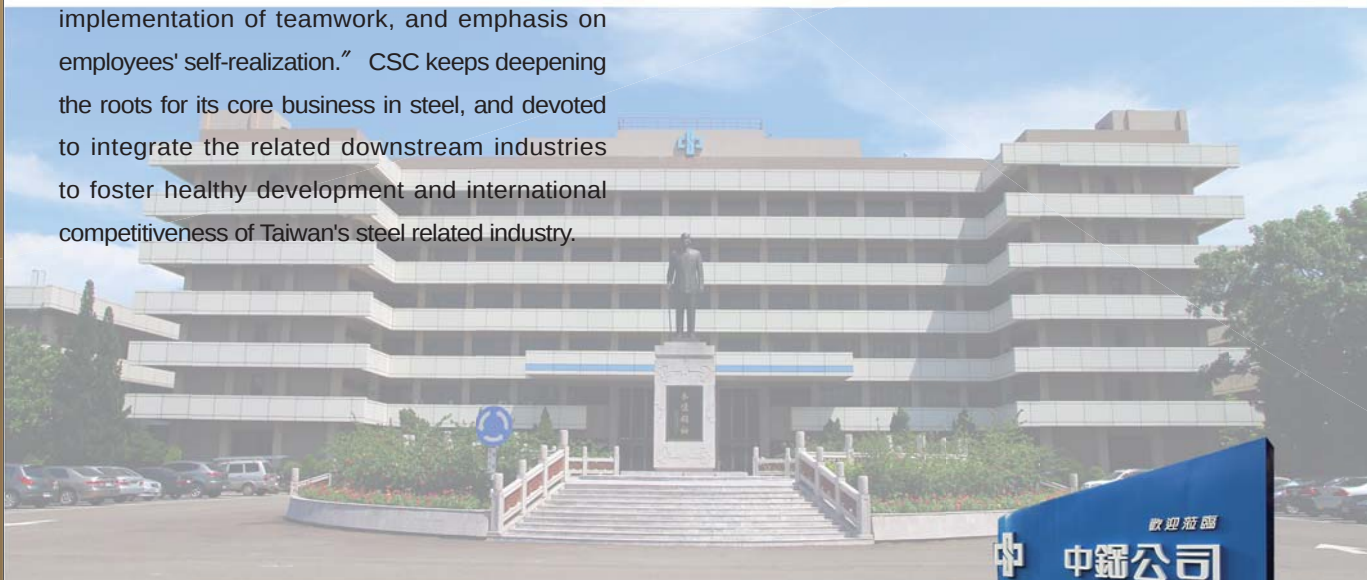


China Steel Corporation (CSC), located at Kaohsiung, Taiwan was founded in December 1971. With annual capacity (in terms of crude steel) around 10 million tonnes, CSC produces a range of products that includes plates, bars, wire rods, hot and cold rolled coils, electrogalvanized coils, electrical steel coils, hot-dip galvanized coils, and Ti/Ni-base alloy. The domestic market takes roughly 65% of CSC's production and the exports take the remaining 35%. CSC is the largest steel company in Taiwan, enjoying more than 50% of the domestic market. Major export destinations are Mainland China, Japan and Southeast Asia.

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 trustworthy steel company of global distinction that pursues growth, environmental protection, energy saving and value-innovation". CSC actively puts into practice its corporate values of "teamwork, entrepreneurial approach, down-to-earthiness and pursuit of innovation", as well as its operations beliefs of "promotion of social well-being, result orientation, implementation of teamwork, and emphasis on employees' self-realization." CSC keeps deepening the roots for its core business in steel, and devoted to integrate the related downstream industries to foster healthy development and international competitiveness of Taiwan's steel related industry.



Plant Greening



China Steel Corporation(CSC), founded in 1971, is an integrated steelmaking company in Taiwan. The establishment of CSC offers the essential steels for the infrastructure which were necessarily imported from foreign countries previously, leading to a great boom in the country and industry. Contributed from the affordable high-quality steels provided by CSC, the steel-related down stream industry is bloomed and create a lot of world No.1 industries. This is an excellent evidence of “materials must be advanced before the promotion of industry” . Since the high quality materials are the key to promote the upgrading of industry in a nation, excellent materials not only can create refined products, but also can lead the rapid growth and upgrading of industry and corresponding products. Therefore, CSC is dedicated to the development of specialty alloys, such as Ti alloys, Ni-base alloys, and tool steels, for contributing to the whole specialty alloys industry and realizing the company vision of being a supplier of various industrial materials.

Based on the concept of “Technology Upgraded, Quality Advanced” , the research-production-sale team for specialty alloys that associated with down stream manufacturing companies are devoted to develop specialty alloys with excellent quality and affordable price, including heavy plates, bars & wire rods, and hot/cold rolled coils.

The vision of CSC's customer service is to gain customer's appreciation and trust and help them be successful, and the aim of that is to promote customers' technology and update the specialty alloy 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 specialty alloy products have gained the acceptance of domestic industries widely, and CSC has also been selected as the first priority provider to purchase their needed specialty alloy 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 Titanium Alloy /Ni-based alloy products' international competitiveness.

ASTM B265(Titanium and Titanium Alloy Plate, Sheet and Coil)

Pure Titanium and Titanium Alloys possess high strength-to-weight ratio, excellent low-temperature resistance and corrosion resistance, high temperature strength at 400~500 °C , small thermal expansion coefficient and high fatigue strength,so they are widely used in the equipment for high temperature environment, including aircraft equipment, petroleum and petrochemical, biomaterial, ocean and chemical industry, for example: blade, storage tank, target, tube and heat-exchanger equipment.

ASTM B409 (Nickel-Iron-Chromium Alloy Plate, Sheet and Strip)

Nickel-Iron-Chromium alloys have been widely used for its strength at high temperature and its ability to resist oxidation, carburization, and other types of high-temperature corrosion. It is useful for many applications involving long-term exposure to elevated temperature and corrosive atmosphere. Applications include furnace components and equipment, petrochemical furnace tubes, and sheathing for electrical heating elements. The properties of Nickel-Based Alloy that make it an excellent choice for seawater applications, springs, seals, bellows for submerged controls, electrical cable connectors, fasteners, flexure devices, and oceanographic instrument components. It also used in power generation for steam superheating tubing and high-temperature heat exchangers in gas-cooled nuclear reactors.

ASTM B348(Titanium and Titanium Alloy Bar)

Pure Titanium and Titanium Alloys possess high strength-to-weight ratio, excellent low-temperature resistance and corrosion resistance, high temperature strength at 400~500 °C , small thermal expansion coefficient and high fatigue strength,so they are widely used in the component for high temperature environment, including aircraft equipment, petroleum and petrochemical, biomaterial, ocean and chemical industry, for example: artificial joints, rotating shaft, golf head, hand tools, screw and nut.

ASTM B863(Titanium and Titanium Alloy Wire)

Pure Titanium and Titanium Alloys possess high strength-to-weight ratio, excellent low-temperature resistance and corrosion resistance, high temperature strength at 400~500 °C , small thermal expansion coefficient and high fatigue strength,so they are widely used in the component for high temperature environment, including aircraft equipment, petroleum and petrochemical, biomaterial, ocean and chemical industry, for example: joint, bolt, screw and nut.

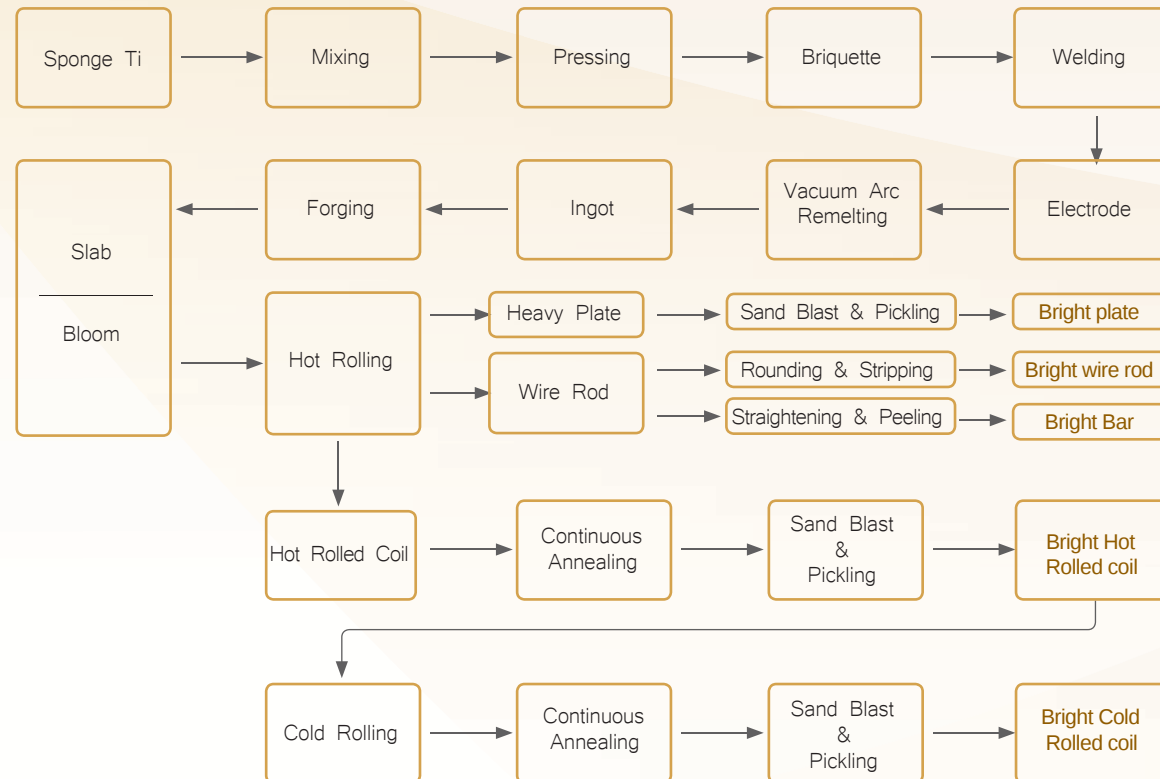


ISO 9001 Certificate

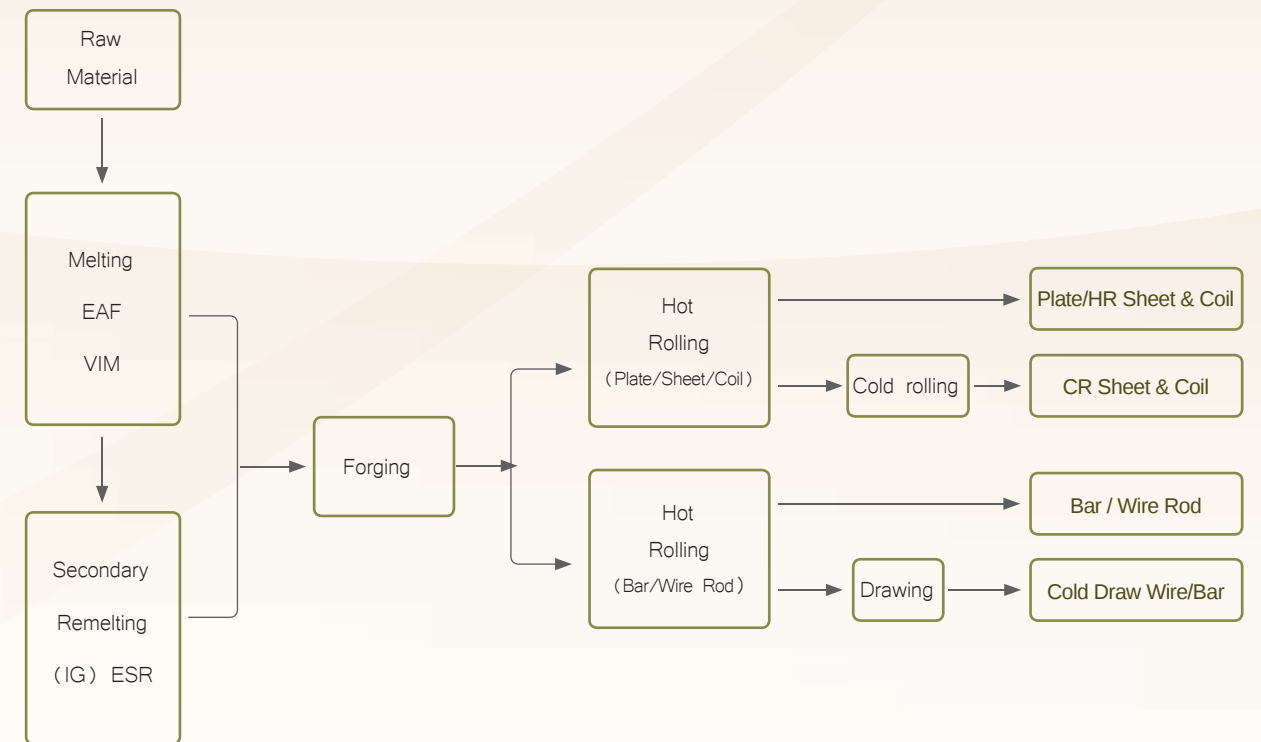


IECQ Certificate

5.1 Titanium Products



5.2 Nickel Based Alloy



5.3 Major Equipments

6300 Tons Press



This oil hydraulic press with 6300 tons press granular sponge Titanium into sponge Titanium block for the electrode of Vacuum Arc Remelting.

3 Tons Vacuum Arc Remelting Furnace (VAR)



VAR furnace melt the sponge Titanium electrode into Titanium ingot under inert gas or vacuum via 2~3 times melting.

VIM (Nickel-Based Alloy)



Melting raw materials in vacuum can suppress the formation of non-metallic oxides and remove the unwanted trace elements. Accurate ingot composition can be achieved.

IG-ESR (Nickel-Based Alloy)



Coarse non-metallic inclusion can be eliminated, and dense and uniform microstructure can be obtained by performing the electroslag remelting.

Heating Furnace



Heating Furnace heats the ingot to improve the deformation ability of ingot for forging the ingot to slab for hot rolling.

1600 Tons Forging Facility



By this 1600-tons Forging Press, round ingot can be forged as slab, bloom or billet.

6.1 Bar and Wire Rod



Welding metal or filler material application by using Alloy 625 wire



Components/parts application for high efficiency gas turbines in car industries by using Alloy A-286 wire

6.2 Sheet and coil



Inner chamber material application for high temperature furnace by using Alloy 800H plate



The welding tube produced by pure Titanium cold-rolled coil

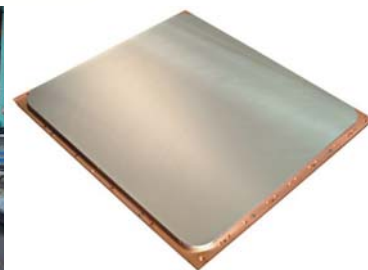


The heat-exchanger equipment produced by pure Titanium cold-rolled coil.

6.3 Plate



The chemical storage tank produced by pure Titanium heavy plate.



Pure Titanium heavy plate is used in electro-optical industry: low oxygen Titanium target for LCD



Petrochemical or chemical industrialequipment/components application by using Alloy 800H plate

7.1 Chemical Compositions and Mechanical Properties

7.1.1 ASTM B265 Titanium and Titanium Alloy Strip, Sheet and Plate

Grade	Chemical Compositions %									Mechanical Properties						
										Tension Test				Bend Test		
	C	O	N	H	Fe	Al	V	Other (IDV)	Other (Sum)	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Gage Length in. (mm)	% min	Bend Angle	Thickness (t) in. (mm)	Inside Radius
Grade1	0.08 max.	0.18 max.	0.03 max.	0.015 max.	0.20 max.	—	—	0.10 max.	0.40 max.	20~45 (138~310)	35 (242) min.	2 (50)	24	105°	0.07 (1.79) max. 0.07~0.187 (1.80~4.75)	1.5t 2.0t
Grade2	0.08 max.	0.25 max.	0.03 max.		0.30 max.	—	—			40~65 (276~448)	50 (345) min.	2 (50)	20		0.07 (1.79) max. 0.07~0.187 (1.80~4.75)	2.0t 2.5t
Grade5	0.08 max.	0.20 max.	0.05 max.		0.40 max.	5.50~6.75	3.50~4.50			120 (828) min.	130 (897) min.	2 (50)	10		0.07 (1.79) max. 0.07~0.187 (1.80~4.75)	4.5t 5.0t

Remarks : 1. Other elements(IDV) include Mn, Si, Al, Cu, Ni, Cr, Mo, V, Nb, B, Sn, Co, Zr(Zirconium), W(Tungsten), Y(Yttrium),

Ta(Tantalum), Bi(Bismuth), Ru(Ruthenium), Hf(Hafnium), Pd(Palladium) etc.

2. Other elements(Sum) = Mn+Si+Ni+Cr+Mo+Cu+Nb+V+Al+B+W+Co+Zr+Hf+Sn+Bi+Ru+Pd+Ta+Y.

3. Minimum and maximum limits apply to tests taken both longitudinal and transverse to the direction of rolling.

4. Bend tests are not applicable to material over 0.187 in. (4.75mm) in thickness.

5. For grade 5 the elongation on materials under 0.025 in. (0.635mm) in thickness may be obtained only by negotiation.

6. The values in () are only for reference.

7.1.2 ASTM B863 Titanium and Titanium Alloy Wire

Grade	Chemical Compositions %									Mechanical Properties			
										Tension Test			
	C	O	N	H	Fe	Al	V	Other (IDV)	Other (Sum)	Yield Point ksi (N/mm²)	Tensile Strength ksi (N/mm²)	Gage Length	%
Grade 2	0.08 max.	0.25 max.	0.03 max.	0.015 max.	0.30 max.	—	—	0.10 max.	0.40 max.	40 (276) min.	50 (345) min.	4D	18 min.
Grade 5	0.08 max.	0.20 max.	0.05 max.		0.40 max.	5.50~6.75	3.50~4.50			120 (828) min.	130 (897) min.	4D	10 min.

Remarks : 1. Other elements(IDV) are include Mn, Si, Al, Cu, Ni, Cr, Mo, V, Nb, B, Sn, Co, Zr(Zirconium), W(Tungsten), Y(Yttrium), Ta(Tantalum),

Bi(Bismuth), Ru(Ruthenium), Hf(Hafnium), Pd(Palladium) etc.

2. Other elements(Sum) = Mn+Si+Ni+Cr+Mo+Cu+Nb+V+Al+B+W+Co+Zr+Hf+Sn+Bi+Ru+Pd+Ta+Y.

3. The values in () are only for reference.

4. D=Diameter of wire.

7.1.3 ASTM B409 Nickel-Iron-Chromium Alloy Plate, Sheet and Strip

Grade (UNS)	Chemical Compositions %											Mechanical Properties			
												Tension Test			
	C	Si	Mn	S	Al	Cu	Ni	Cr	Ti	Fe	Al+Ti	Yield Point ksi (N/mm ²)	Tensile Strength ksi (N/mm ²)	Gage Length in. (mm)	% min
N08800	0.10 max.	1.00 max.	1.50 max.	0.015 max.	0.15~ 0.60	0.75 max.	30.0~ 35.0	19.0~ 23.0	0.15~ 0.60	39.50 min.	—	30 (207) min.	75 (518) min.	2 (50)	30min.
N08810	0.05~ 0.10										—	25 (173) min.	65 (449) min.	2 (50)	30min.
N08811	0.06~ 0.10										0.85~ 1.20	25 (173) min.	65 (449) min.	2 (50)	30min.

- Remarks : 1. Yield Strength requirements do not apply to material under 0.020 in.(0.51mm) in thickness.
2. Mechanical Properties for Hot/Cold rolled sheet/strip are available only in thickness 0.115 in.(2.92mm) and over.
3. Elongation of cold roll strip is not applicable for thickness under 0.010 in.(0.25mm).
4. The values in () are only for reference.

7.1.4 ASTM B348 Titanium and Titanium Alloy Bars and Billets

Grade	Chemical Compositions %									Mechanical Properties				
										Tension Test				
	C	O	N	H	Fe	Al	V	Other (IDV)	Other (Sum)	Yield Point ksi (N/mm ²)	Tensile Strength ksi (N/mm ²)	Gage Length in. (mm)	%	Reduction of Area %
Grade 2	0.08 max.	0.25 max.	0.03 max.	0.015 max.	0.30 max.	—	—	0.10 max.	0.40 max.	40 (276) min.	50 (345) min.	4D	20 min.	30 min.
Grade 5	0.08 max.	0.20 max.	0.05 max.		0.40 max.	5.50~ 6.75	3.50~ 4.50			120 (828) min.	130 (897) min.	4D	10 min.	25 min.

- Remarks : 1. Other elements(IDV) are include Mn, Si, Al, Cu, Ni, Cr, Mo, V, Nb, B, Sn, Co, Zr(Zirconium), W(Tungsten), Y(Yttrium), Ta(Tantalum), Bi(Bismuth), Ru(Ruthenium), Hf(Hafnium), Pd(Palladium) etc.
2. Other elements(Sum) = Mn+Si+Ni+Cr+Mo+Cu+Nb+V+Al+B+W+Co+Zr+Hf+Sn+Bi+Ru+Pd+Ta+Y.
3. These properties apply to longitudinal sections up to 3 in. (76mm) in thickness. Mechanical properties of larger Sections shall be negotiated between the manufacturer and the purchaser.
4. The values in () are only for reference.
5. D=Diameter of Bar.

7.2 Tolerances

7.2.1 Titanium and Titanium Alloy

7.2.1.1 ASTM B265 Thickness Tolerances of Titanium Plates

Unit: mm

Tol. / Width (w) Thickness (t)	$800 \leq w \leq 2134$	$2134 < w \leq 3048$	$3048 < w \leq 3658$	$3658 < w \leq 3800$
$4.76 \leq t < 9.53$	1.14	1.27	—	—
$9.53 \leq t < 19.05$	1.39	1.52	1.90	2.28
$19.05 \leq t < 25.40$	1.52	1.65	2.15	2.54
$25.40 \leq t < 50.80$	1.77	1.90	2.41	2.92
$50.80 \leq t \leq 76.20$	3.17	3.81	4.44	5.08

Remarks : 1. The minus side of thickness tolerances shall be -0.25mm.

2. Thickness is measured along the longitudinal edges of the plate at least 3/8 in. (9.53mm), but not more than 3 in. (76.20mm) from the edge.

7.2.1.2 ASTM B265 Thickness Tolerances of Titanium Sheets and coils

Unit: mm

Tol. / Width (w) Thickness (t)	$610 \leq w \leq 2134$	
	Upper Limit	Lower Limit
$0.20 \leq t < 0.42$	0.05	— 0.05
$0.42 \leq t < 0.67$	0.07	— 0.07
$0.67 \leq t < 1.02$	0.10	— 0.10
$1.02 \leq t < 1.48$	0.12	— 0.12
$1.48 \leq t < 1.84$	0.15	— 0.15
$1.84 \leq t < 2.12$	0.17	— 0.17
$2.12 \leq t < 2.50$	0.20	— 0.20
$2.50 \leq t < 2.91$	0.22	— 0.22
$2.91 \leq t < 3.31$	0.25	— 0.25
$3.31 \leq t < 3.69$	0.30	— 0.30
$3.69 \leq t < 4.76$	0.35	— 0.35

7.2.1.3 ASTM B348 Dimensional Tolerances of Titanium Bars

Unit: mm

Tol. / Diameter (d)	Size Variation		Out of Round (Square) max.
	Upper Limit	Lower Limit	
$5.50 \leq d < 7.94$	0.12	— 0.12	0.20
$7.94 \leq d < 11.12$	0.15	— 0.15	0.22
$11.12 \leq d < 15.88$	0.17	— 0.17	0.25
$15.88 \leq d \leq 22.22$	0.20	— 0.20	0.30

7.2.1.4 ASTM B863 Dimensional Tolerances of Titanium Wire Rods

Unit: mm

Tol. / Diameter (d)	Size Variation		Out of Round max.
	Upper Limit	Lower Limit	
$0.51 \leq d \leq 1.15$	0.025	— 0.025	0.038
$1.15 < d \leq 1.58$	0.038	— 0.038	0.050
$1.58 < d \leq 2.29$	0.050	— 0.050	0.063
$2.29 < d \leq 4.75$	0.076	— 0.076	0.076
$4.75 < d < 6.35$	0.101	— 0.101	0.101

7.2.1.5 ASTM B265 Width and Length Tolerances of Titanium Plates

Unit: mm

Specified Dimensions		Upper Limit of Tolerance on Length and Width for Thickness (t)					
Length (L)	Width (w)	t ≤ 9.52		9.52 < t ≤ 15.87		t > 15.88	
		Width	Length	Width	Length	Width	Length
L < 3048	w < 1524	9.52	12.70	11.11	15.87	12.70	19.05
	1524 ≤ w < 2134	11.11	15.87	12.70	17.46	15.87	22.22
	2134 ≤ w < 2743	12.70	19.05	15.87	22.22	19.05	25.40
	w ≥ 2743	15.87	22.22	19.05	25.40	22.22	28.57
3048 ≤ L < 6096	w < 1524	9.52	19.05	12.70	22.22	15.87	25.40
	1524 ≤ w < 2134	12.70	19.05	15.87	22.22	19.05	25.40
	2134 ≤ w < 2743	14.28	22.22	17.46	23.81	20.63	28.57
	w ≥ 2743	15.87	25.40	19.05	28.57	22.22	31.75
6096 ≤ L < 9144	w < 1524	9.52	25.40	12.70	28.57	15.87	31.75
	1524 ≤ w < 2134	12.70	25.40	15.87	28.57	19.05	31.75
	2134 ≤ w < 2743	14.28	25.40	17.46	28.57	22.22	34.92
	w ≥ 2743	17.46	28.57	22.22	31.75	25.40	34.92
9144 ≤ L < 12192	w < 1524	11.11	28.57	12.70	31.75	15.87	38.10
	1524 ≤ w < 2134	12.70	31.75	15.87	34.92	19.05	38.10
	2134 ≤ w < 2743	14.28	31.75	19.05	34.92	22.22	38.10
	w ≥ 2743	19.05	34.92	22.22	38.10	25.40	41.27
12192 ≤ L < 15240	w < 1524	11.11	31.75	12.70	38.10	15.87	41.27
	1524 ≤ w < 2134	12.70	34.92	15.87	38.10	19.05	41.27
	2134 ≤ w < 2743	15.87	34.92	19.05	38.10	22.22	41.27
	w ≥ 2743	19.05	38.10	22.22	41.27	25.40	44.45
L ≥ 15240	w < 1524	12.70	44.45	15.87	47.62	19.05	47.62
	1524 ≤ w < 2134	15.87	44.45	19.05	47.62	22.22	47.62
	2134 ≤ w < 2743	15.87	44.45	19.05	47.62	22.22	47.62
	w ≥ 2743	22.22	44.45	25.40	50.80	28.57	57.15

Remarks : The lower limit tolerance on specified length and width is -6.3 mm.

7.2.1.6 ASTM B265 Width and Length Tolerances of Titanium Sheets and Coils

Unit: mm

Specified Dimensions		Upper Limit of Tolerance on Length and Width for Thickness (t)	
Length (L)	Width (w)	0.20 ≤ t ≤ 4.75	
		Width	Length
L < 3048	610 ≤ w < 1220	1.58	6.35
	1220 ≤ w ≤ 1524	3.17	6.35
3048 ≤ L < 6096	610 ≤ w < 1220	1.58	12.70
	1220 ≤ w ≤ 1524	3.17	12.70

Remarks : The lower limit tolerance on specified length and width is 0 mm.

7.2.1.7 ASTM B265 Flatness Tolerances of Titanium Plates

Unit: mm

Tol. max. 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 < 3658	3658 ≤ w < 3800
4.76 ≤ t < 6.35	19.05	26.98	31.75	34.92	41.27	41.27			
6.35 ≤ t < 9.53	17.46	19.05	23.81	28.57	34.92	36.51	36.68	47.62	
9.53 ≤ t < 12.70	12.70	14.28	17.46	19.05	23.81	28.57	31.75	36.51	44.45
12.70 ≤ t < 19.05	12.70	14.28	15.87	15.87	20.63	28.57	28.57	28.57	34.92
19.05 ≤ t < 25.40	12.70	14.28	15.87	15.87	19.05	20.63	23.81	25.40	28.57
25.40 ≤ t < 38.10	12.70	14.28	14.28	14.28	17.46	17.46	17.46	19.05	25.40
38.10 ≤ t ≤ 76.20	4.76	7.93	9.52	11.11	12.70	14.28	15.87	19.05	22.22

7.2.2 Nickel-Iron-Chromium Alloy

7.2.2.1 ASTM B409 Thickness Tolerances of Nickel-Iron-Chromium Plates

Unit: mm

Tol. Width (w) Thickness (t)	$800 \leq w \leq 2134$	$2134 < w \leq 3048$	$3048 < w \leq 3658$	$3658 < w \leq 3800$
$6.00 \leq t < 9.52$	1.14	1.27	—	—
$9.52 \leq t < 19.05$	1.39	1.52	1.90	2.28
$19.05 \leq t < 25.40$	1.52	1.65	2.15	2.54
$25.40 \leq t < 50.80$	1.77	1.90	2.41	2.92
$50.80 \leq t \leq 76.20$	3.17	3.81	4.44	5.08

Remarks : 1. The minus side of thickness tolerances shall be -0.25mm.

2. Thickness is measured along the longitudinal edges of the plate at least 3/8 in. (9.53mm), but not more than 3 in. (76.20mm) from the edge.

7.2.2.2 ASTM B409 Thickness Tolerances of Nickel-Iron-Chromium Sheets and Coils

Unit: mm

Tol. Width (w) Thickness (t)	$610 \leq w \leq 1219$	
	Upper Limit	Lower Limit
$0.46 \leq t \leq 0.63$	0.07	— 0.07
$0.63 < t \leq 0.86$	0.10	— 0.10
$0.86 < t \leq 1.09$	0.12	— 0.12
$1.09 < t \leq 1.42$	0.15	— 0.15
$1.42 < t \leq 1.77$	0.17	— 0.17
$1.77 < t \leq 1.98$	0.20	— 0.20
$1.98 < t \leq 2.36$	0.22	— 0.22
$2.36 < t \leq 2.76$	0.25	— 0.25
$2.76 < t \leq 3.17$	0.30	— 0.30
$3.17 < t \leq 3.55$	0.35	— 0.35
$3.55 < t \leq 4.34$	0.38	— 0.38
$4.34 < t \leq 4.74$	0.43	— 0.43

Remarks : Thickness is measured along the longitudinal edges of the plate at least 3/8 in. (9.53mm).

7.2.2.3 ASTM B409 Width Tolerances of Nickel-Iron-Chromium Plates

Unit: mm

Tol. Width (w) Thickness (t)	$w \leq 762$		$762 < w \leq 1828$		$1828 < w \leq 2743$		$2743 < w \leq 3657$		$3657 < w \leq 4064$	
	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit
$4.76 \leq t < 7.93$	4.76	- 3.17	6.35	- 3.17	9.52	- 3.17	12.70	- 3.17	—	—
$7.93 \leq t < 12.70$	6.35	- 3.17	9.52	- 3.17	9.52	- 3.17	12.70	- 3.17	15.87	- 3.17
$12.70 \leq t < 19.05$	9.52	- 3.17	9.52	- 3.17	12.70	- 3.17	15.87	- 3.17	19.05	- 3.17
$19.05 \leq t < 25.40$	12.70	- 3.17	12.70	- 3.17	15.87	- 3.17	19.05	- 3.17	22.22	- 3.17
$25.40 \leq t \leq 31.75$	15.87	- 3.17	15.87	- 3.17	19.05	- 3.17	22.22	- 3.17	25.40	- 3.17
$31.75 < t \leq 60$	4.76	- 3.17	4.76	- 3.17	4.76	- 3.17	4.76	- 3.17	4.76	- 3.17

7.2.2.4 ASTM B409 Length Tolerances of Nickel-Iron-Chromium Plates

Unit: mm

Tol. Width (w) Thickness (t)	$w \leq 1524$		$1524 < w \leq 2438$		$2438 < w \leq 3048$		$3048 < w \leq 6000$	
	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit
$4.76 \leq t < 7.93$	4.76	- 3.17	6.35	- 3.17	9.52	- 3.17	12.70	- 3.17
$7.93 \leq t < 12.70$	9.52	- 3.17	12.70	- 3.17	12.70	- 3.17	12.70	- 3.17
$12.70 \leq t < 19.05$	12.70	- 3.17	12.70	- 3.17	15.87	- 3.17	15.87	- 3.17
$19.05 \leq t < 25.40$	15.87	- 3.17	15.87	- 3.17	15.87	- 3.17	19.05	- 3.17
$25.40 \leq t \leq 31.75$	19.05	- 3.17	19.05	- 3.17	19.05	- 3.17	22.22	- 3.17
$31.75 < t \leq 60$	4.76	- 3.17	4.76	- 3.17	4.76	- 3.17	4.76	- 3.17

7.2.2.5 ASTM B409 Width Tolerances of Nickel-Iron-Chromium Sheets and Coils

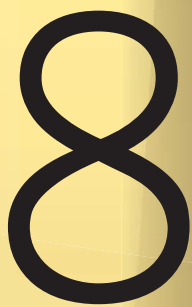
Unit: mm

Width (w)	Width Tolerance	
	Thickness: 1.20~6.35	
	Upper	Lower
$610 \leq w \leq 1524$	3.17	0

7.2.2.6 ASTM B409 Flatness Tolerances of Nickel-Iron-Chromium Plates

Unit: mm

Tol. max. Thickness (t)	Width (w) $800 \leq w < 1219$	$1219 \leq w < 1524$	$1524 \leq w < 1829$	$1829 \leq w < 2134$	$2134 \leq w < 2438$	$2438 \leq w < 2743$	$2743 \leq w < 3048$	$3048 \leq w < 3658$	$3658 \leq w < 3800$
$6.00 \leq t < 6.35$	19.05	26.98	31.75	34.92	41.27	41.27			
$6.35 \leq t < 9.53$	17.46	19.05	23.81	28.57	34.92	36.51	36.68	47.62	
$9.53 \leq t < 12.70$	12.70	14.28	17.46	19.05	23.81	28.57	31.75	36.51	44.45
$12.70 \leq t < 19.05$	12.70	14.28	15.87	15.87	20.63	28.57	28.57	28.57	34.92
$19.05 \leq t < 25.40$	12.70	14.28	15.87	15.87	19.05	20.63	23.81	25.40	28.57
$25.40 \leq t < 38.10$	12.70	14.28	14.28	14.28	17.46	17.46	17.46	19.05	25.40
$38.10 \leq t \leq 76.20$	4.76	7.93	9.52	11.11	12.70	14.28	15.87	19.05	22.22



8.1 Titanium Plates, Sheet and Coil

Unit: mm

Grade	Product Type	Available Size				
		Thickness	Width	Length	Inside Diameter	
					Dull	Bright
ASTM B265 GR.1 ASTM B265 GR.2	Plates	6.00~60.00	1000~2500	3000~6000	—	
	HR Coils	3.00~3.99	900~1100	—	729	610
		4.00~6.00	900~1200	—	729	610
	HR Sheets	3.00~3.99	900~1100	1000~6000	—	
		4.00~6.00	900~1200	1000~6000	—	
	CR Coils	0.60~2.50	1000~1200	—	729	610
ASTM B265 GR.5	CR Sheets	0.60~2.50	1000~1200	1000~6000	—	
	Plates	6.00~50.80	1000~2500	3000~6000	—	

8.2 Nickel-Iron-Chromium Plates, Sheet and Coil

Unit: mm

Grade	Product Type	Available Size		
		Thickness	Width	Length
ASTM B409 N08800	Ni-based Alloy Plate	6.01~60.00	1000~2400	3500~6000
ASTM B409 N08810	Ni-based Alloy Sheet	3.01~60.00	1000~1800	1000~6000
ASTM B409 N08811	Ni-based Alloy Plate	4.01~70.00	100~350	250~500

8.3 Titanium Bars and Wire Rods

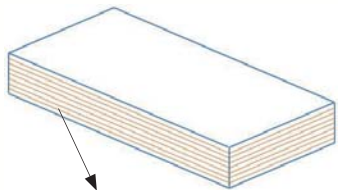
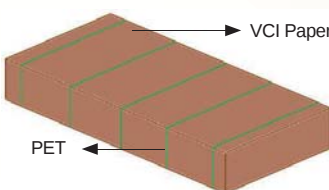
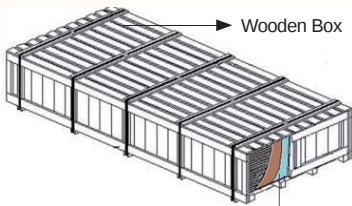
Grade	Product Type		Available Size (mm)				Mass (kg)
			Length	Diameter	ID	OD	
ASTM B348 GR.1	Wire Rod		—	2.50~12.00	850	1250	100~1400
ASTM B348 GR.2	Bar	Bar in Coil	—	14.00~30.00	890~970	1320~1450	100~1400
		Straight Round Bar	1000~3000	2.50~10.00 16.00~25.00	—	—	—
	Wire Rod		—	2.50~12.00	850	1250	100~1400
ASTM B863 GR.5	Wire Rod		—	2.50~12.00	850	1250	100~1400

9.1 Sheet/Plate

(1) Marking

Stencil	Label		
Marking at the upper surface of the product	Stick on wooden box package		
CSC ASTM B265 Gr.2 JA5612A001 10995C 8.0x1500x4000mm 6G780		中國鋼鐵股份有限公司 CHINA STEEL CORPORATION	
	客戶 Customer	SUGA	
	品名 Prod Name	TITANIUM PLATE	
CSC Specification Order no Plate no Name Size (TxWxL) Heat no	規格 Spec.	ASTM B265-09a GR.2	
	訂單 Order No.	LP6502A001	
	尺寸 Size	8.0×1200× 4000 mm	片數 Pieces 2
	淨質量 Net mass		總質量 Gross mass 346kg

(2) Packing

Interleaving Paper Package	VCI Paper Package	Wooden Box Package
 Interleaving Paper	 VCI Paper PET	 Wooden Box PE Film

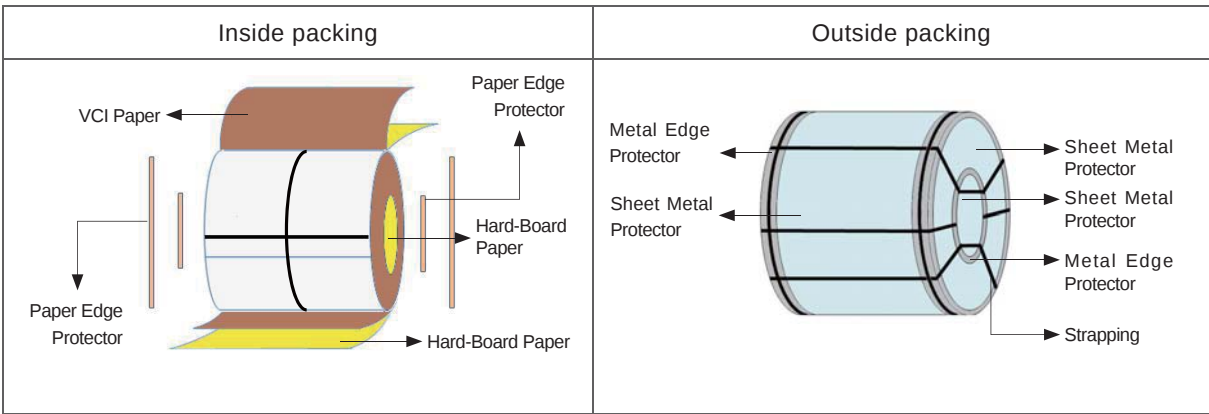
9.2 Hot rolled and cold rolled coil

(1) Marking



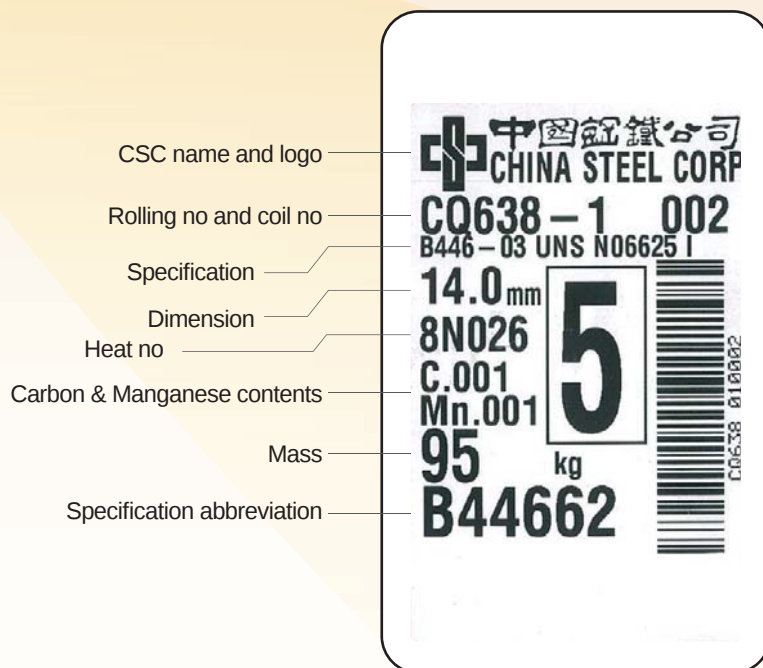
Making Item	1	2	3	4	5	6	7	8	9
	CSC logo	CSC name	Product name	Specification	Size	ID No	Net mass	Gross mass	Heat No.

(2) Packing



9.3 Bar and wire rod

(1) Marking



(2) Packing

PE Film	Cloth Packing	Wooden Box Packing
		



10.1 Titanium and Titanium Alloy

1. Do not scratch the dirty on the surface by iron and steel tools.
2. Do not contact something containing fluoride.
3. Self-ignition and stress corrosion fracture would occur in below environment:
Fuming nitric acid, pure oxygen, methyl solution, hydrochloric acid, high temperature hypochlorite, 300~450°C fused salt, carbon disulfide, n-hexane and dry chlorine.
4. Hydrogen crack may occur in below situation:
 - (1) Over 80°C hydrogen environment, Titanium would pick up hydrogen apparently. Over 300°C, Titanium reacts with hydrogen violently, forming large amount hydrogen compound inside.
 - (2) The diffusion rate of hydrogen atom in Titanium increases apparently while temperature is over 80°C. Hydrogen crack problem should be noticed as Titanium is used in high temperature and corrosion environment, for example; pH<3, pH>12, contacting with carbon steel or stainless steel, and H₂S environment.
 - (3) As Titanium is used for cathodic protection, the electric potential of room temperature should be higher than -0.75V.

10.2 Nickel-Based Alloy

1. Heating

When Nickel-Based Alloy is heated, it must be taken to maintain both the furnace and the material being heated at the proper temperature. Fuels used for heating must be extremely low in sulfur due to the high sensitivity of Nickel-Based Alloy to sulfur. The furnace atmosphere of sulfur content for heating or annealing should be kept in the lowest level, and the sulfur-containing needs to be less than 0.25g/cm³ in coal gas and 0.5% in heavy oil. The alloy must be absolutely clean and free from paint, lubricant oil, fuel oil, and metals with low melting point (such as Pb, Sn, In) when it is charged into the furnace.

2. Heat Treatment and Mechanical Properties

Nickel-Based Alloys are divided into two types, i.e. solution-annealed and precipitation-hardened according to the applications of the products. Proper heat treatment will be applied to enhance the mechanical properties of the Nickel-Based Alloys according to different grade and conditions of environment to achieve the requirements for mechanical properties.

3. Hot Forming and Ingot Quality

The sufficiently powerful equipment for hot forming will be used due to the high deformation resistance of Nickel-Based Alloys. The ways and conditions of hot forming for Nickel-Based Alloys will be performed according to their specific characteristics. The special casting methods (e.g. electric arc furnace, electroslag remelting, vacuum induction melting, and vacuum arc remelting) for the ingot of the Nickel-Based Alloy will be chosen according to its quality requirement and application.

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CONVERSION TABLES

Length	ft	inch	mm	m
	1	12	304.8	0.3048
	0.083333	1	25.4	0.0254
	0.003281	0.03937	1	0.001

Mass	1kg = 2.20462 lb
------	------------------

Force	1kgf = 9.80665 N
-------	------------------

Stress	ksi (=1000psi)	psi	kgf/mm ²	N/mm ² (MPa)
	1	1000	0.70307	6.89476
	0.001	1	7.0307×10^{-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

12

12.1 Plates

Required Ordering Data		Example
1	Specification	ASTM/ASME
2	Grade	B265/SB265 GR.1/2/5
3	Order Size (Thickness×Width×Length)	8.00~50.80mm×1500mm×6000mm
4	Order Piece	7 pieces
5	Application	Pressure Vessels
6	Edge Status	Mill Edge or Cut Edge
7	Delivery Condition	As Rolled/Solution Annealed/Sand Blast & Pickled
8	Special Requirements (If required)	UT examination

12.2 Sheets or Coils

Required Ordering Data			Example
1	Specification		ASTM
2	Grade		B265 GR.1/2
3	Order Size (Thickness×Width×Length or Coil)		1.60mm×1200mm×Coil
4	Inside and Outside Diameter		ID 762mm ， OD 1700mm max.
5	Mass	Maximum Mass	10t
		Order Mass	150t
6	Applicartion		Heat exchanger
7	Delivery Condition		As Rolled/Solution Annealed/Sand Blast & Pickled
8	Surface Status (Dull 、Bright)		NO.1/NO.2D/BA/BA-S

12.3 Bars or Wire Rods

Required Ordering Data			Example
1	Specification		ASTM
2	Grade		B863/B348 GR.1/2/3/4/5/9
3	Order Size (Diameter×ID×OD)		5.50~33.00mm×850mm×1250mm
4	Mass	Each Bundle	2.25t
		Order Mass	150t
5	Application		Screw
6	Delivery Condition		As Rolled/Draw/Solution Annealed/Peeling & Finishing/Grinding & Finishing

- 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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 | Contact person : Chang Hsiao-Pang | E-mail : 167155@mail.csc.com.tw

2.Metallurgical Department

Technical Service Section-Metallurgy : 886-7-8021335
 Metallurgical Specification and Testing Section : 886-7-8021111 Ext. 3261, 2207, 2208



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