



Duplex Stainless Steel

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TAIYUAN IRON & STEEL (GROUP) CO., LTD.

Content

01 Brief Introduction

02 Process Flow

03 Advanced Equipment

08 Research and Development

09 Quality Assurance System

10 Honors and Rewards

11 Proprietary Intellectual Rights

12 Product & Character

19 Product Specification

20 Products Application

20 Consumer Evaluation

21 Material Certificate

21 Package

22 The Service Promise

24 Contacting Manners of the Main Business Sections

Enterprise mission

Providing the Excellent Stainless Steel Products to Consumers

Strategic Target

Building TISCO into the Most Competitive Stainless Steel Producer in the World

Core Values

Relying on the People, Putting Customers' Needs First, Rejuvenating Enterprise through Quality, Fully Opening, Keeping Innovative

Marketing Principle

Providing Customer with Better and Faster Solution Package to Realize Long-Term Win-Win Cooperation

Shanxi TISCO Stainless Steel Co.,Ltd.



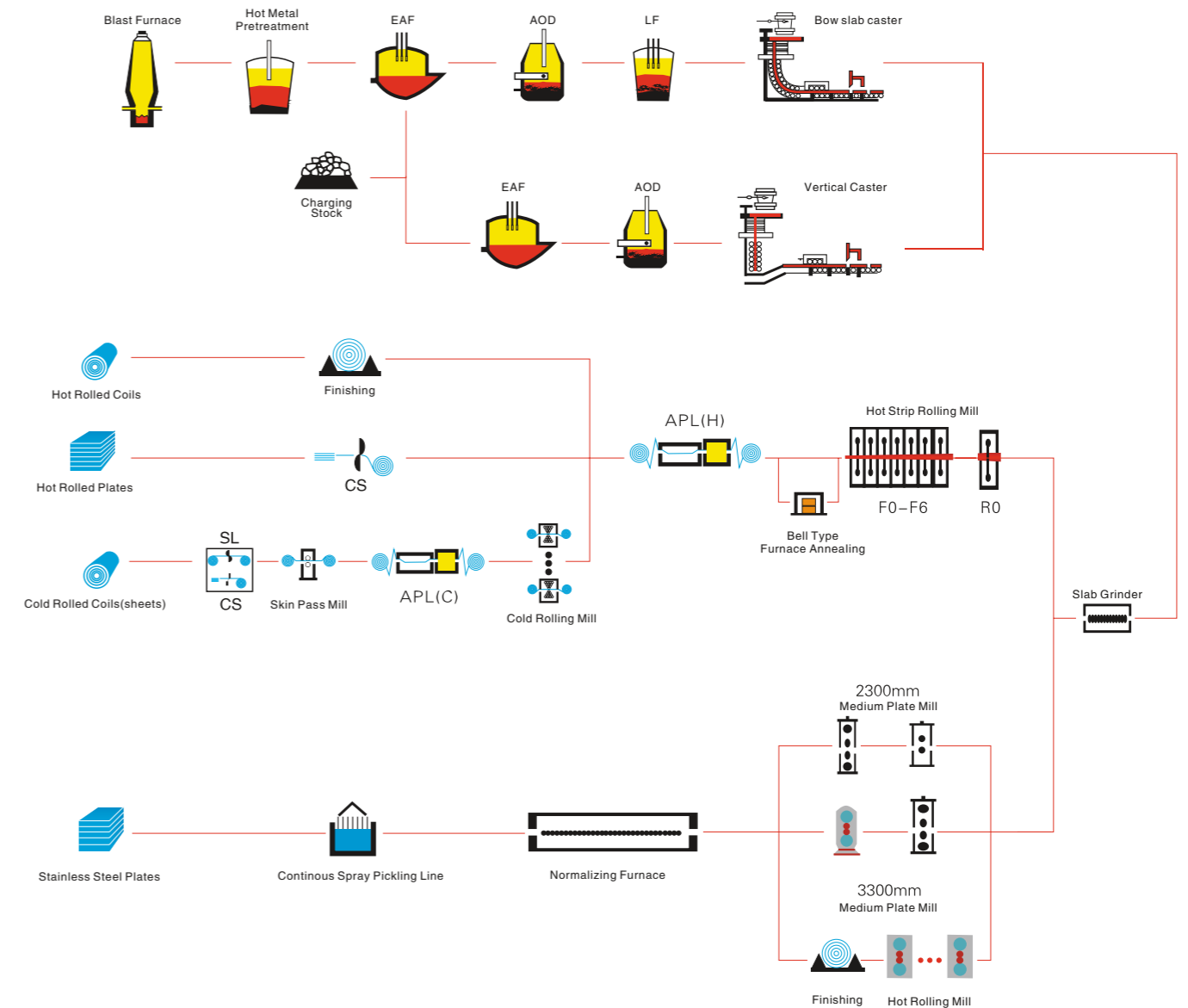
Taiyuan Iron and Steel (Group) Co. Ltd. (TISCO) is one of the steel giants in China and, the largest stainless producer in the world in term of capacity equipped with the most advanced facilities covering pretty wide product range. After over 70 years development TISCO has the capacity of 10 million tons of steel, which includes 3 million tons of stainless. The year of 2009 saw TISCO become No.1 stainless producer in the world with production of 2.48 million tons of stainless.



In TISCO came out the first heat of stainless steel and first heat of silicon steel as well as the first sheet of silicon in the history of China steel industry. TISCO is well equipped for mining and iron ore refining, iron and steel making, rolling and forging, metallurgical equipment and spare parts manufacturing. TISCO's products cover stainless steel of cold and hot rolling, cold rolled silicon, hot rolled coil, axle steel, die steel and steel for military purpose etc. TISCO's products are widely used in petrochemical industry, transportation, construction decoration, home appliance, medical and food industry. TISCO's products can be also found in the national key projects such as Shenzhou spaceship, Chang'e-1 Moon Detector, Dongfeng rocket series and nuclear power, Three Gorges, West-East natural gas transmission, and Olympic game facility as well as Shanghai world expos. In 2009 TISCO technology centre ranked No.2 among the 575 state acknowledged enterprise technology institutions, and No.1 among the steel industry. TISCO owns 745 core patents in the field of stainless and over 100 patents are taken as the world class.

TISCO is aiming to become the most competitive stainless producer in the world, and achieve the first class stainless product in terms of product range, quality, cost, R&D, energy saving, environment protection, efficiency and service. For this goal TISCO is trying the first world class level and build itself into the world competitive large group company.

Process Flow >>>



Advanced Equipment >>>



Ultra-high-power Electric Arc Furnace (EAF)

The use of EAF for melting alloys optimizes the preparation of hot metal and pre-melting alloys. 90t and 160t ultra-high-power EAF are capable of charging stock combinations, accurate in the making of homogenous composition and excellent for furnace and machines compatibility.



90t K-OBM-S Converter

K-OBM-S, featured for its big furnace volume, dense oxygen blowing and short smelting period, is capable of providing clean and pure melt steel to VOD with automatic slag stopping device equipped. It is designed with intelligent steel-smelting system to achieve high hitting rate.



Straight-bow Slab and Bloom Combined Caster, Broad Slab Caster

It is the only slab and bloom combined caster in China and the widest stainless steel slab caster in the world, using the automatic mold level control technology, equipped with electric magnetic stirrer (EMS). The bloom is cooled homogeneously by the secondary dynamic cooling water, air-mist cooling, hydraulic vibrator, and is metallographically compacted by applying softening reduction technology.

Advanced Equipment >>>



90t VOD Converter

High vacuum capacity, powerful stirring performance, vacuum degree ≤ 0.5 Torr, stirring capacity 1200 L³/h; High in steel purity [C] ≤ 25 ppm, [H] ≤ 2 ppm; S% $\leq 0.005\%$; Σ (Pb+As+Sn+Sb+Bi) $\leq 0.01\%$; It is suitable for ultra-low carbon, nitrogen stainless steel production, C+N ≤ 100 ppm



45t, 180t AOD Furnace

High de-carbon efficiency by top bottom blow. Using the top grade scrap as the raw material, EAF+AOD as the smelt process, the molten steel is pure, low in residue composition, less impurities. AOD uses the intelligent smelting system achieving precise and stable composition control with minimized fluctuation.



Vertical Slab Caster

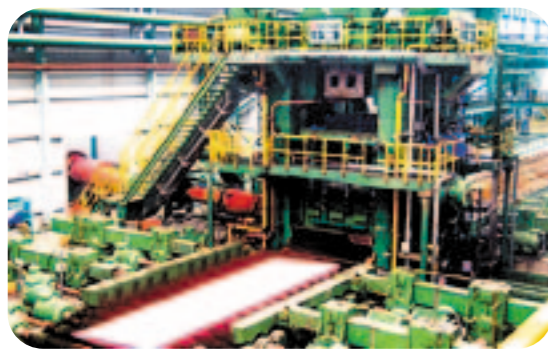
Vertical slab caster makes impurities float up freely and improve purity. The slab goes without bending and stretching, and comes with less inner defects. As the mold is designed with non-sinus hydraulic vibrator, electro magnetic vortex level control system and secondary dynamic cooling water and others, the metallographic structure of slab is therefore uniform and compact.

Advanced Equipment >>>



Continuous Normalizing Line for Medium Plates

The temperature control of the 50m continuous normalizing furnace is precise and the unconfined-nucleus rimming quencher make the stainless steel plate fast cool down. (The cooling speed >25℃/s).



Broad Medium Plate Mill

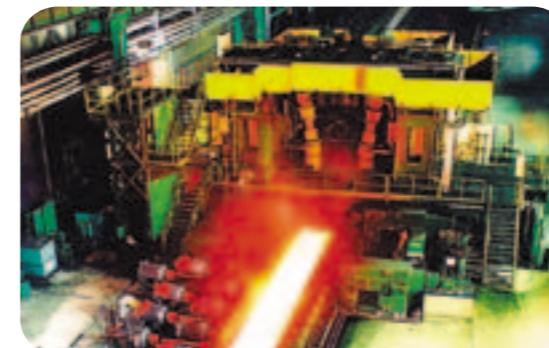
Stainless steel medium plate with max. width of 3000mm and max. thickness of 100mm. Equipped with the advanced AGC automatic control system, its products have high accuracy dimension and good flatness.



Continuous Pickling Line for Medium Plates

By continuous spraying and pickling the stainless steel medium plates, scratch sources are minimized. China's first this line secures the surface colour uniformity.

Advanced Equipment >>>



1549mm Hot Strip Mill

Adoption of the advanced AWC, AGC control systems secures the high accuracy achieved of dimension control. Use of the advanced hydraulic bending and axial shifting technology in combination of the edge heater makes it possible to produce a wider range of products with better quality control.



2250mm Hot Strip Mill

2250mm hot strip mill and its control system represent the currently most advanced level of traditional hot strip mill cluster in the world. The latest CVC technology is used for profile control system, hydraulic AGC control for screw down system. Hot coil box and high efficient cooling device ensure good profile and excellent dimension accuracy for various specifications of products.



Hot-rolling Coils Annealing and Pickling Line

It is the most advanced & largest hot-rolling coils annealing and pickling line with 1.1 million tons of annual production capacity. Equipped with the scale breaker in front of shot blaster and pickling section, the pre-treatment capacity is strengthened before pickling, and on-line skin pass mill comes after pickling section.

Advanced Equipment >>>



Sendzimir cold-rolling mill

The most advanced cold-rolling mill in the world equipped with AGC AFC, its products have high accuracy, excellent flatness and small thickness tolerance.



Cold-rolling Coils Annealing and Pickling Line

It has cleaning and degreasing functions, ensuring good surface quality and stable & uniform property of products.

Research and Development >>>



Scanning Electron Microscope



Transition Electron Microscope

National level laboratory



Tisco technology center ranks 2th place among enterprise-based 575 technology centers accredited by the state



Thermal Simulating Tester



Thermal Analyser

Quality Assurance System >>>

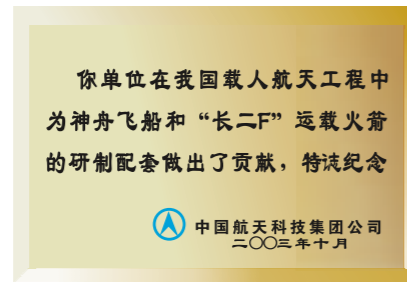


Honors and Rewards >>>



Proprietary Intellectual Rights >>>

- 《Technical Development on High-quality Stainless Steel Plates》 and 《Nitrogen-containing Stainless Steel Technology and Products Development》 are awarded the second prizes of National Science & Technology Progress Reward.
- 《AOD Campaign, Process and Technological Development》 and other two are honored as the first and second prizes of Shanxi Province Science & Technology Progress Reward.
- 《Research and Development of Nitrogen -containing Stainless Steel in TISCO》 and other eight are honored the first, second and third prizes respectively of Metallurgical Science & Technology Rewards.
- 《Clad Plates of Duplex Stainless Steel》 and other five are honored the New Products Reward of National Key Projects and Excellent Reward of New Products of Shanxi Province respectively.
- Stainless steel 2B plates are rated by Science & Technology Ministry as the National Hi & New-tech Products.
- 《Nitrogen Alloying Process with AOD-used Nitrogen》 《De-nitrogenization Process in the High Carbon Zones of VOD Smelting Stainless Steel》 and so on in total of 86 items are awarded as the patents.



Product & Character >>>

■ Characteristics & Applications

- It has high strength because yield strength of it is twice of that of 18-8 type stainless steel. Good pit
- corrosion resistance and stress corrosion resistance, small tendency of welding heat crack, large
- conductivity and small linear expansion coefficient of it are suitable to manufacture line of facilities, tube of
- heat exchange and produce clad plate. In addition, it has high rate of work hardening, high energy
- absorption and high shock resistance.

■ Chemical composition

Material Code		Mass percent (%)								
		C	Si	Mn	P	S	Cr	Ni	Mo	N
2101 (S32101、1.4162)	ASTM	≤0.040	≤1.00	4.00-6.00	≤0.040	≤0.030	21.0-22.0	1.35-1.70	0.1-0.8	0.20-0.25
	Typical value	0.028	0.71	5.03	0.028	0.001	21.50	1.55	0.30	0.22
2304 (S32304、1.4362)	ASTM	≤0.030	≤1.00	≤2.50	≤0.040	≤0.030	21.5-24.5	3.0-5.5	0.05-0.60	0.05-0.20
	Typical value	0.026	0.50	1.28	0.028	0.001	23.50	4.05	0.30	0.12
2205 (S31803、S32205、1.4462)	ASTM ^a	≤0.030	≤1.00	≤2.00	≤0.030	≤0.020	21.0-23.0	4.5-6.5	2.5-3.5	0.08-0.20
	ASTM ^b	≤0.030	≤1.00	≤2.00	≤0.030	≤0.020	22.0-23.0	4.5-6.5	3.0-3.5	0.14-0.20
2507 (S32750、1.4410)	ASTM	≤0.030	≤1.00	≤1.20	≤0.035	≤0.020	24.0-26.0	6.0-8.0	3.0-5.0	0.24-0.32
	Typical value	0.026	0.55	0.78	0.028	0.001	25.5	7.40	4.10	0.28

a:According to S31803 standard,
b:According to S32205 standard.



Product & Character >>>

Mechanical Properties

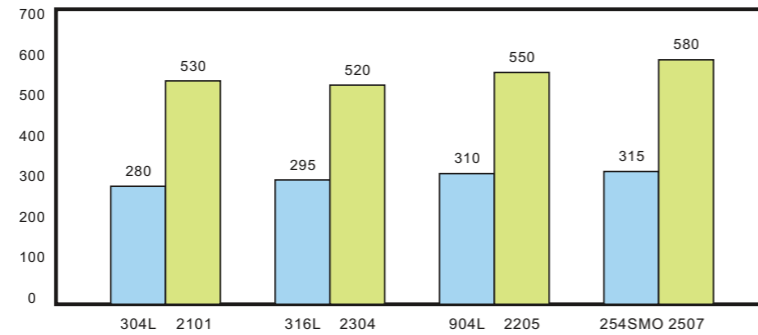
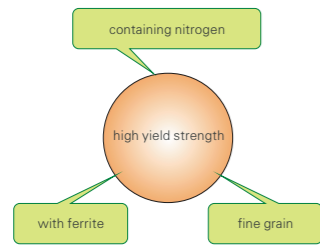
- Mechanical properties at ambient temperature

Material Code		Rp0.2/MPa	Rm/MPa	A/%	HB
2101 (S32101、 1.4162)	ASTM	≥450	≥620	≥25	≤293
	Typicalvalue	530	720	33	240
2304 (S32304、 1.4362)	ASTM	≥400	≥600	≥25	≤293
	Typicalvalue	520	710	35	245
2205 (S31803、 S32205、 1.4462)	ASTM ^a	≥450	≥620	≥25	≤293
	ASTM ^b	≥450	≥655	≥25	255
	Typicalvalue	550	750	33	≤293
2507(S32750、 1.4410)	ASTM	≥550	≥795	≥15	260
	Typicalvalue	580	850	31	≤310

a:AccordingtoS31803standard.
b:AccordingtoS32205standard.

Typical value is 12mm steel plate measured data.

- Comparing with the yield strengths in room temperature of duplex stainless and austenitic stainless steel

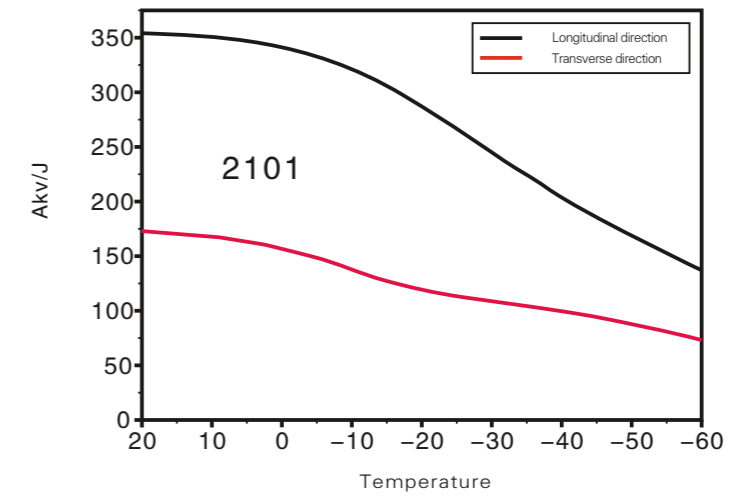


- Mechanical properties at high temperature

Material Code	Temperature	Typical value		
		Rp0.2/MPa	Rm/MPa	A/%
2304 (S32304、 1.4362)	100	330	570	31
	200	290	530	29
2205 (S31803、 S32205、 1.4462)	100	470	710	37
	200	393	680	32
2507(S32750、 1.4410)	100	525	720	30
	200	470	700	30

Product & Character >>>

- Impact performance



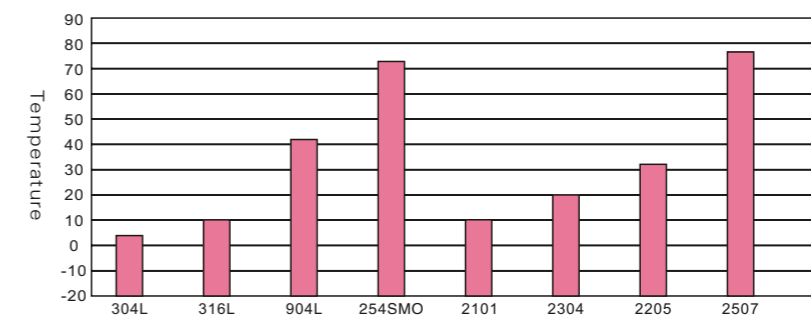
Corrosion resistance

- The pitting corrosion resistances usually take PREN as an assessment standard for reference.

Materials grade	Material Code	Cr	Mo	N	PREN
Austenitic stainless steel	304L	18.50	-	0.03	18.98
	316L	17.10	2.5	0.03	25.83
	904L	20.0	4.3	0.03	34.67
	254SMO	19.7	6.05	0.20	42.87
Duplex stainless steel	2101	21.50	0.30	0.22	26.01
	2304	23.50	0.30	0.12	26.41
	2205	22.10	3.10	0.17	35.05
	2507	25.50	4.10	0.28	43.51

PREN = %Cr+3.3%Mo+16%N

- Critical pitting corrosion temperature (CPT) °C. Testing standard ASTM G150 (CPT varies according to the differences in the shape of product and the condition of surface polishing)



Product & Character >>>

■ Weldability

Keeping phases balance in heat affected zone(HAZ) is the most important for duplex stainless steel. It can successfully avoid the precipitated phases.

The most of welding methods for austenitic stainless steels are suitable to the duplex stainless steels. Such as SMAW, TIG(GTAW), MIG(GMAW), (FCAW)and (SAW).

■ General rules for welding

- No pre-heating of welding.
- Weld interpass temperature $\leq 150^{\circ}\text{C}$, Temperature for 2507 $\leq 100^{\circ}\text{C}$.
- Special welding material for duplex stainless steel are needed.
- Heat input varies with the composition and thickness of duplex stainless steels.



Product & Character >>>

■ Physical properties

■ thermal conductivity

Material code	temperature				
	20	100	200	300	400
2101	15	16	18	19	20
2304	16	17	18	19	20
2205	19	19	21	23	24
2507	16	17	19	20	22

■ coefficient of linear expansion

钢材编号 Material code	temperature			
	20-100	20-200	20-300	20-400
2101	13.2	14.1	14.7	14.9
2304	13	14.3	14.4	14.6
2205	13.7	14.2	14.7	14.9
2507	12.5	14.1	14.3	14.7

■ specific heat

Material code	temperature				
	20	100	200	300	400
2101	490	530	550	575	605
2304	500	540	565	590	620
2205	470	500	530	560	585
2507	450	475	500	530	550

■ elastic modulus

Material code	temperature				
	20	100	200	300	400
2101	200	191	182	175	170
2304	200	192	183	176	172
2205	200	190	180	170	160
2507	200	189	179	168	159

Product & Character >>>

■ Processing and molding

- hot working and heat treatment temperature

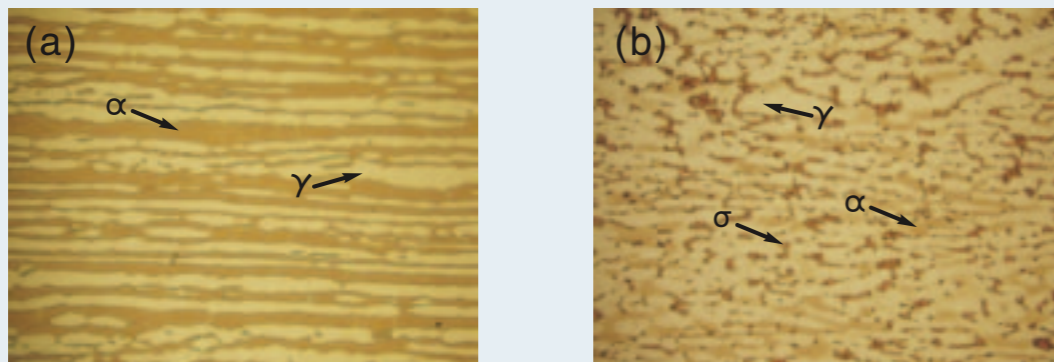
	2101	2304	2205	2507
hot working temperature	900~1100	900~1100	950~1150	1020~1200
heat treatment temperature	1020~1080	1020~1080	1020~1100	1050~1120

The precipitated phase in duplex stainless steel may result in the embrittlement, therefore, the application performances would be affected

The formation temperature range of σ intermetallic phases is about 600~950°C. For ferritic stainless steel, the transformation temperature is between 350~525°C (475°C brittleness). For this reason, the application temperature for duplex stainless steel should be below 250°C.

Differing from 2507 and 2205, 2101 duplex stainless steel is not sensitive to intermetallic phases precipitation and easily be controlled in heat treating and welding.

- metallographic microscopes for duplex stainless steel(a: no σ phase, b: with σ phase)

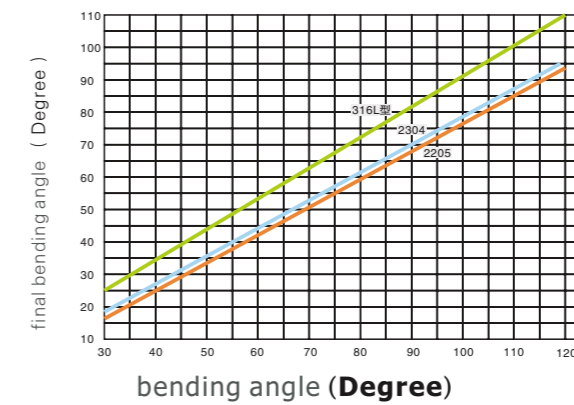


Product & Character >>>

- cold forming ability

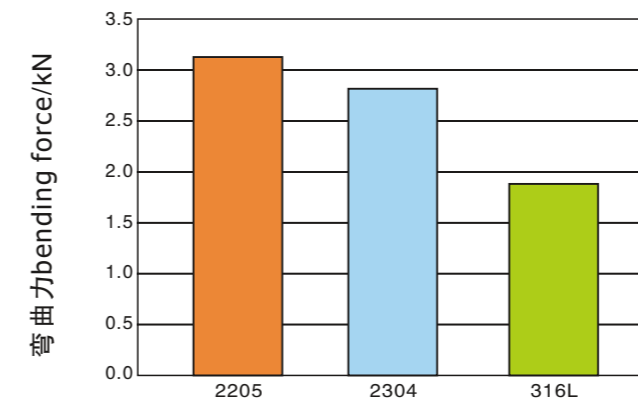
Compared with the austenitic stainless steel, duplex stainless steel has higher strength and need large force for molding. Because of material thickness reducing, the influence of this strength is much smaller expectation. The rebound effects will be obvious during bending.

Comparing results of rebound resiliometers for 2mm thick duplex stainless steel and 316L steel



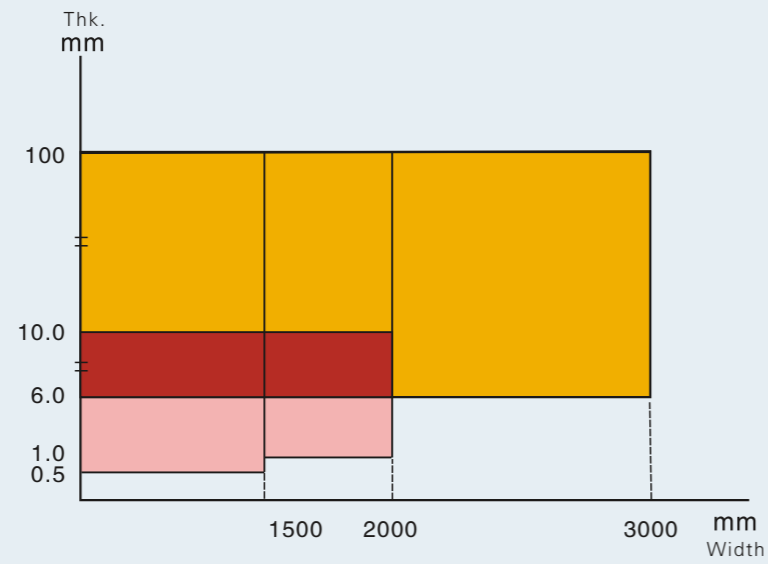
The minimize external forces during the initial stage of the bending for duplex stainless steel and 316L steel

(thickness2mm, width50mm)

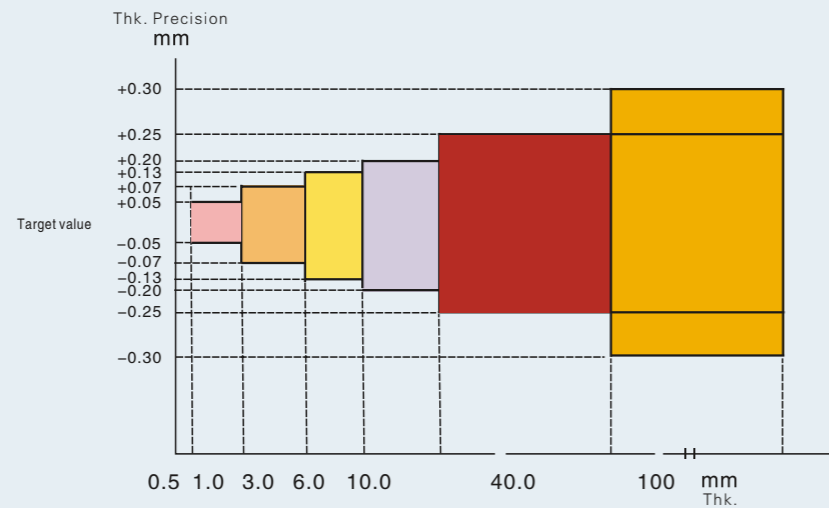


Figures quote from 《INTERNATIONAL MOLYBDENUM ASSOCIATION》

Product Specification >>>



Products thickness tolerance and precision control



Products Application >>>



Consumer Evaluation >>>

TISCO duplex stainless steel has stable composition , excellent performance, excellent corrosion resistance, fast delivery and the timely provision of technical services, which fully meet the design and use requirements.



Material Certificate >>>

GENERAL INFORMATION		SPECIFICATION	
Product Name	STAINLESS STEEL	Grade	S30400
Material No.		Standard	ASTM A304
Quantity		Weight	10000 kg
Manufacturer	HANSHENG STEEL CO., LTD.	Country	CHINA
Issue Date	2023-10-27	Issue No.	001
CHEMICAL COMPOSITION (%)		MECHANICAL PROPERTIES	
C	0.025	Yield Strength (MPa)	205
Mn	0.035	Tensile Strength (MPa)	520
P	0.005	Elongation (%)	40
S	0.005	Reduction of Area (%)	60
Si	0.035	Impact Energy (J)	30
N	0.010	Hardness (HV)	150
Cr	18.00		
Ni	8.00		
Mo	0.01		
Cu	0.01		
Al	0.01		
Fe	Balance		

The Service Promise >>>

- Providing consumers with the customized design in composition, properties, package, coil weight and quality certificate.
- Delivery in time : lead time is within 30 days.
- Providing technical support to customers in selecting materials, processing, welding technology and applicability etc.
- Consumer's complains will be answered within 24 hours and settled within a week.



Package >>>

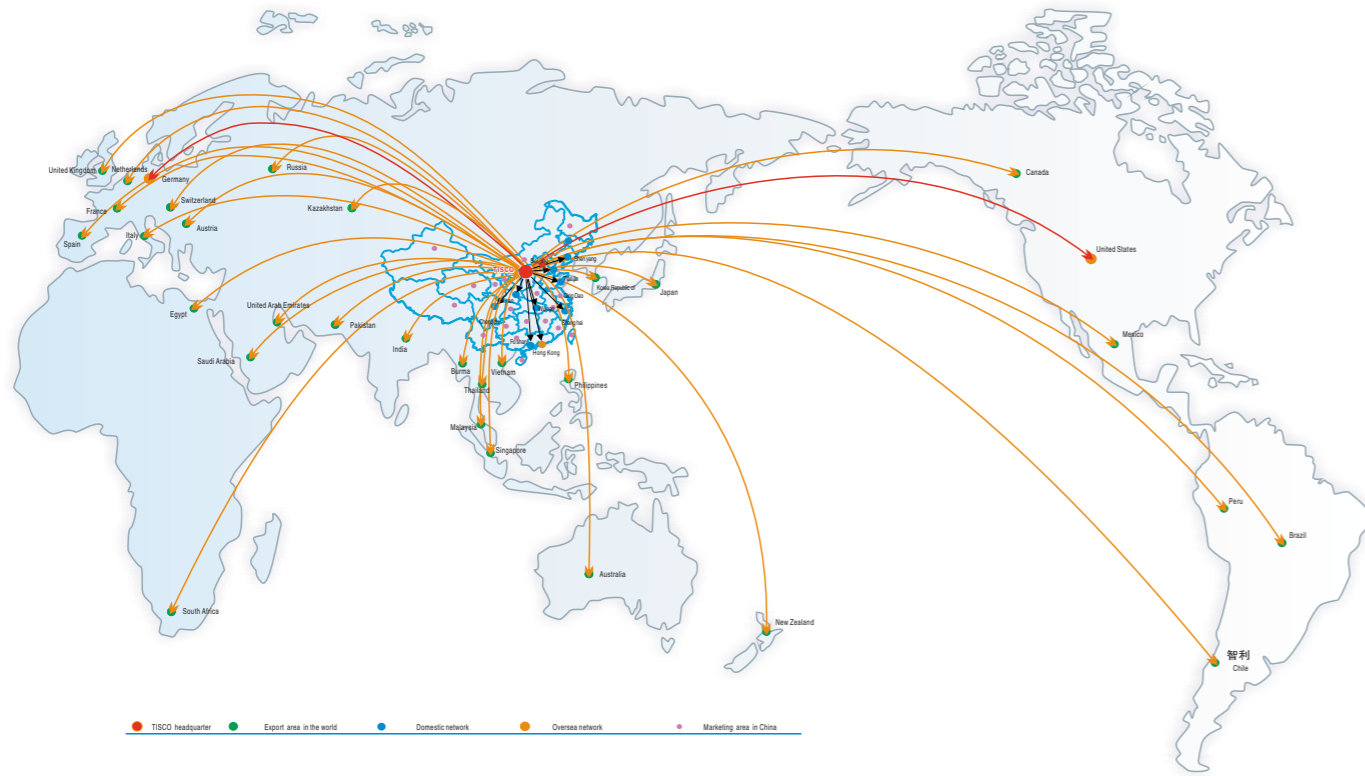
- Employment of waterproof and damp-proof materials.
- Damage avoided with protecting plank and shim.
- Coil loosening and scratching prevented as a result of vertical and horizontal tying up between coil layers.



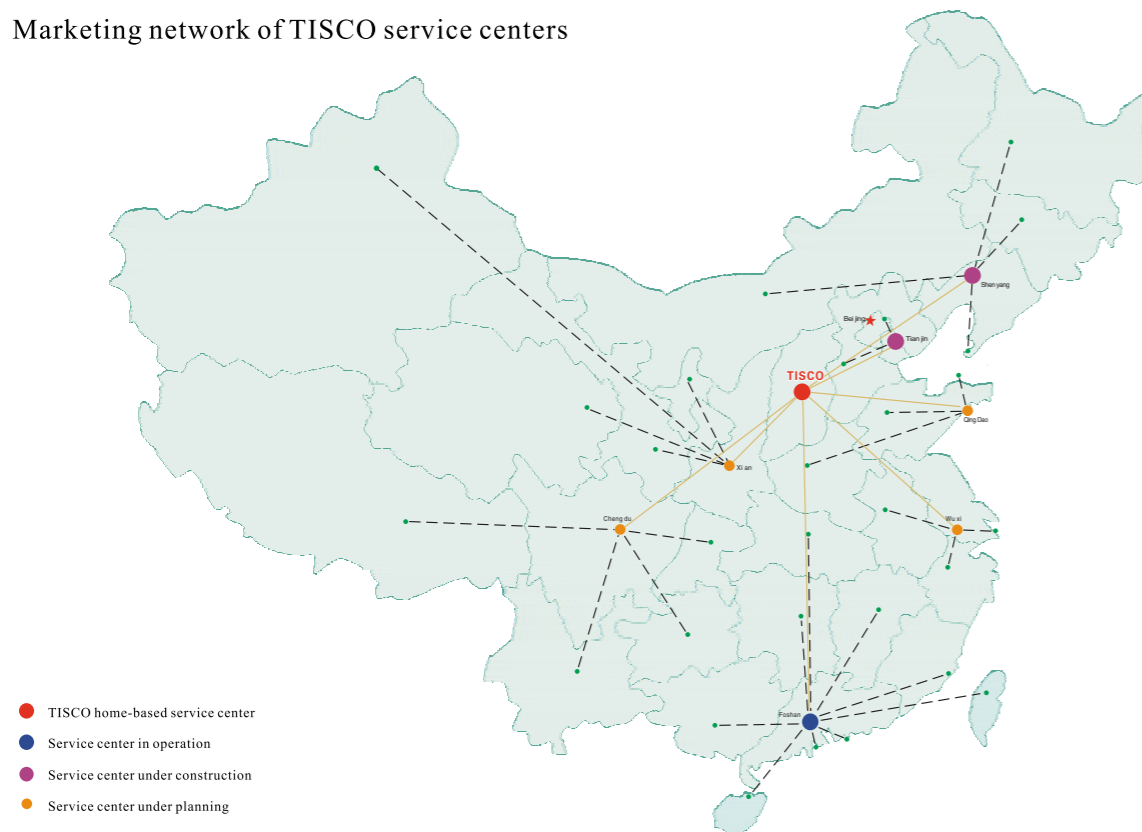
- Medium plate package with water-proof material, strengthened frame to prevent plate from deformation.



■ TISCO products distribution and marketing network in the world



■ Marketing network of TISCO service centers



Contacting Manners of the Main Business Sections >>>

Main business department	Functions	Telephone	E-mail
Marketing Department	Contract and order management Complaint and claim handing	0351-3010673 0351-3010679 800-806-1998 400-653-1998	tgxsc@tisco.com.cn Tgyhfwk@tisco.com.cn
Technology Center	Technical consultation service	0351-3016424 0351-3012213	Tgjszxbxg@tisco.com.cn
Steel Trade Department	Exports business	+86 (0)351-3017169 +86 (0)351-3017525	Tggm@tisco.com.cn

Contacting manners of deomestic trading Co.,Ltd

	Branch Name	Address	Telephone & Fax	
			Telephone	Fax
TISCO sales company in North China	Tianjin TISCO Sales Co. Ltd.	Tianjin	Tel: 022-24308105	Fax 022-24308103
	Beijing TISCO Sales Co. Ltd.	Beijing	Post code) 300012 Tel: 010-64441368	Fax 010-64441369
	Spot Sales company Ltd. of TISCO	Taiyuan	Post code: 100029 Tel: 0351-3096390	Fax 0351-3090556
	Zhengzhou TISCO Sales Co. Ltd.	Zhengzhou	Post code: 030003	
TISCO sales company in Northeast of China	Liaoning TISCO Sales Co. Ltd.	Shenyang	Tel: 024-24232050	Fax 024-24231216
	Haerbin TISCO Sales Co. Ltd.	Haerbin	Post code: 110016	
TISCO sales company in East China	Wuxi TISCO Sales Co. Ltd.	Wuxi		
	Shanghai TISCO Sales Co. Ltd.	Shanghai	Tel 0510-82407713	Fax 0510-82441187
	Hangzhou TISCO Sales Co. Ltd.	Hangzhou	Post code 214011	
TISCO sales company in Shandong	Qingdao TISCO Sales Co. Ltd.	Qingdao	Tel 0532-81101847	Fax 0532-87734798
	Jinan TISCO Sales Co. Ltd.	Jinan	Post code 266000	
TISCO sales company in Central China	Wuhan TISCO Sales Co. Ltd.	Wuhan	Tel 027-85615300	Fax 027-85615311
	Changsha TISCO Sales Co. Ltd.	Changsha	Post code 430015	
TISCO sales company in South China	Foshan TISCO Stainless Steel Sales Co. Ltd.	Foshan	Tel 0757-83315711	Fax 0757-83315718
	Jieyang TISCO Sales Co. Ltd.	Jieyang	Post code 528041	
TISCO sales company in Southwest of China	Chengdu TISCO Sales Co. Ltd.	Chengdu	Tel 028-87604342	Fax 028-87612940
	Chongqing TISCO Sales Co. Ltd.	Chongqing	Post code 610036	
TISCO sales company in Northwest of China	Xi'an TISCO Sales Co. Ltd.	Xi'an	Tel 029-86231507 Post code 710016	Fax 029-86231506