

SPECIAL STAINLESS STEEL PRODUCED BY THE VOD PROCESS

SPECIFICATION SHEET

➤ SPECIAL STAINLESS STEEL FOR SPECIAL PURPOSES

VOD (Vacuum Oxygen Decarburization) is a process for refinement of stainless steel through reduction of carbon content under vacuum. The process is based on oxidation of carbon which has to be reduced below 0.1 wt.% for better corrosion resistance of stainless steels.

Molten steel is transferred from EAF into a separate vessel where it is heated by electric current and stirred with argon inert gas. Oxygen is blown on the top of steel in the vacuum chamber. Carbon is oxidized and carbon monoxide/dioxide is formed. Gases as nitrogen, hydrogen, oxygen and carbon monoxide/dioxide are drained out of the vessel with vacuum pumps. Thermodynamical laws under vacuum allow that chromium is not oxidized or very small amounts go into slag as Cr_2O_3 . This makes the VOD process a very good choice for the production of high-chromium steels with low carbon content.

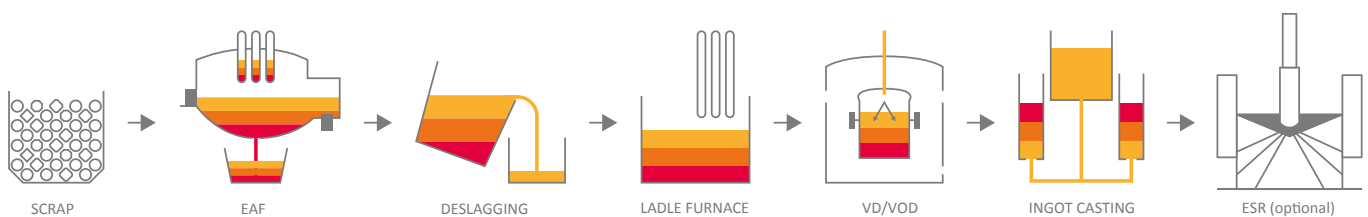


Fig.1: The process of production for a classically cast ingot produced by VOD method and optional ESR remelting

➤ MAIN APPLICATIONS

- applications at high temperatures and in oxidizing environments (e.g. power generation like turbine blades),
- applications where higher resistance to pitting and intergranular corrosion is required,
- chemical industry,
- nuclear power plants,
- tubing,
- construction of treatment plants and plants for energy and construction sectors,
- welding applications,
- aircraft applications.

➤ STEEL PRODUCTION AT SIJ METAL RAVNE via EAF-VOD + ESR

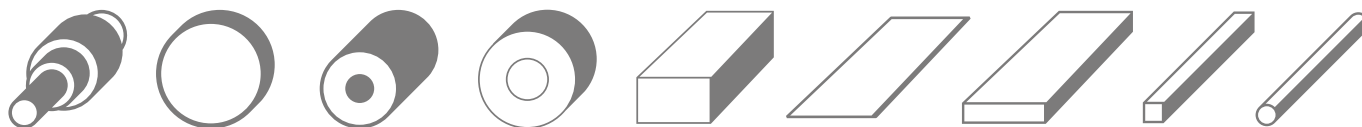
SIJ GRADE:	W. Nr.:	EN/AISI/others:	Standards:	Heat treatment:	Type of stainless steel:	Main applications:
SINOXX ^{***} SINOXX 3952	1.3952	X2CrNiMoN18-14-3	EN 10088-3 EN 10272 EN 10269 EN 10302 SEW 390	Solution annealed / Quenched	Austenitic	Applications: High-voltage electrical apparatus, Bolts and nuts, Transformer tank, Generator, Preparation equipments, Chemical industry, Electronic equipment, Crude oil and petrochemical industries, Medical and pharmaceutical industry.
SINOXX ^{***} SINOXX 4000	1.4000	X6Cr13	EN 10088-3	Soft annealed	Ferritic	Construction of turbines, water and steam resistant ferritic steel components, parts for water turbines, valves, diff. machine parts, comp. for petrochemical and shipbuilding industry. Machines and ships engines (sweet water), paper-, textile and dairy machines, vapor - and water armatures.
	-	AISI 410S	ASTM A240/A240M			
SINOXX ^{***} SINOXX 4003	1.4003	X2CrNi12	EN 10088-3	Soft annealed	Ferritic	The products can be used to produce components and decorative elements in the construction industry, or parts of vehicles in the communication and automotive industries. Steel also found in the food, mining and sugar industries. In addition, X2CrNi12 is easily weldable, has relatively good mechanical properties in annealed condition +A, at room and elevated temperatures. Applications: Sugar Processing industries, Transport equipment such as rail wagons carrying iron ores and coal, Mining & mineral processing, Oven & furnaces, Rail & hoppers, Railroad and road vehicles, Shipping containers, Industrial applications, Petrochemical industry, Agriculture industry, General engineering industries
SINOXX ^{***} SINOXX 4301	1.4301	AISI 304/304L	ASTM A182-A182M ASTM A276/A276M ASTM A479/479M ASTM A484 / A484M ASTM A314-15 ASTM A320/A320M AMS 5639 AMS 5647	Solution annealed / Quenched	Austenitic	The list is endless. Almost every conceivable industry uses some of this material in some way. Everything from stovetops to ball point pen barrels to flatware to fasteners has been fabricated from this alloy.
		UNS S30400	ASTM A473-16			
		X2CrNi18-9	EN 10088-3 EN 10250-4			
		X5CrNi18-10	EN 10088-3 EN 10222-5 EN 10250-4			
		AISI F304N	ASTM A182/A182M			
SINOXX ^{***} SINOXX 4305	1.4305	UNS S30300 AISI 303	ASTM A582/A582M ASTM A895-89 AMS 5640	Solution annealed / Quenched	Austenitic	Used in an incredibly wide variety of parts both in screw and general machining industries. Applications include hardware, fasteners, valve parts, nozzles and trim. For the food processing industry, dairies, fotografic industry, for paint, soap, paper and textile production.
		X8CrNiS18-9	EN 10088-3			
SINOXX ^{***} SINOXX 4313	1.4313	F6NM	EN 10088-3 EN 10222-5 EN 10272 ASTM A182/A182M	Hardened + tempered	Martensitic	Steel is used for parts subjected to high mechanical stress in fittings and pump construction, for compressors and turbines in hydroelectric power stations, and and refrigerating systems.
		X3CrNiMo13-4 X4CrNi13-4 X5CrNi13-4	EN 10088-3 EN 10272 EN 10028 EN 10222-5 EN 10250-4			
		UNS 41500 AISI 415	EN 10088-3 ASTM A240/A240M ASTM A479/A479M	Soft annealed		

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SINOXX ^{***} SINOXX 4401	1.4401	AISI F316/F316L	ASTM A182/A182M ASTM A193/A193M ASTM A276/A276M ASTM A314-15 ASTM A320/A320M ASTM A479/A479M ASTM A484/A484M	Solution annealed / Quenched	Austenitic	Widely used in industry, it was initially designed for paper mill machinery. It has been used in marine environments and a wide variety of general industrial components. Component parts for the cellulose, paper, oil, soap and textile industry, production of paints, meat processing industry, breweries, dairies and for surgical instruments. Also for application in cold extrusion, as a spring steel and steel for pressure purposes.
		X5CrNiMo17-12-2	EN 10088-3 EN 10222-5	Soft annealed		
		B8M	ASTM A193/A193M			
		10X17H13M2T	GOST 5632-72			
SINOXX ^{***} SINOXX 4404	1.4404	X2CrNiMo17-12-2	EN 10088-3 EN 10222-5	Solution annealed / Quenched Soft annealed	Austenitic	Widely used in industry, it was initially designed for paper mill machinery. It has been used in marine environments and a wide variety of general industrial components. Component parts for the cellulose, paper, oil, soap and textile industry, production of paints, meat processing industry, breweries, dairies and for surgical instruments. Also for application in cold extrusion, as a spring steel and steel for pressure purposes.
SINOXX ^{***} SINOXX 4418	1.4418	X4CrNi16-5-1 X4CrNiMo16-5-1	EN10088-3	Hardened + tempered	Martensitic	It is one of the better martensitic grades, showing sufficient corrosion resistance, good strength properties and high hardness with reduced carbon content. Applications: chemical industry, ship building, mechanical engineering, aviation and aerospace.
SINOXX ^{***} SINOXX 4429	1.4429	X2CrNiMoN18-14-3	EN 10088-3 EN 10272 EN 10269 EN 10302 SEW 390	Solution annealed / Quenched	Austenitic	Applications: High-voltage electrical apparatus, Bolts and nuts, Transformer tank, Generator, Preparation equipments, Chemical industry, Electronic equipment, Crude oil and petrochemical industries, Medical and pharmaceutical industry.
SINOXX ^{***} SINOXX 4435	1.4435	X2CrNiMo18-14-3	EN10088-3	Solution annealed / Quenched	Austenitic	Components used in marine environments and chemical equipment. Suitable for any application where 316 stainless is used and stronger welds are desirable.
		AISI F316L	ASTM A182/A182M			
SINOXX ^{***} SINOXX 4462	1.4462	08Ch21N6M2T	GOST 5632-72	Solution annealed / Quenched	Duplex (austenitic + ferritic)	Chemical and oil processing industry. Highly resistant to stress corrosion in chlorine surroundings.
		F51 F60 UNS S31803 UNS S32205	ASTM A182/A182M ASTM A276/A276M ASTM A479/A479M			
SINOXX ^{***} SINOXX 4541	1.4541	X6CrNiTi18-10 X8CrNiTi18-10	EN 10088-3 EN 10250-4 EN 10222-5 EN 10095	Solution annealed / Quenched	Austenitic	Jet engine parts, furnace heat treated parts, expansion joints, turbo superchargers, oil refiners, exhaust manifolds and high temperature chemical production equipment.
		AISI 321	ASTM A182/A182M ASTM A276/A276M AMS 5645			
		08X18H10T	GOST 5632-72 GOST 5949 GOST 10498			
		12X18H9T	AMS 5645			
		12X18H10T	GOST 5632-72			

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SINOXX^{***} SINOXX 4542	1.4542	X5CrNiCuNb 16-4 17-4 PH AISI 630 N700	EN 10088-3 EN 10250-4 AMS 5643 ASTM A564/A564M	Solution annealed + precipitation hardened	Martensitic precipitation hardened	It can be used for a variety of applications including oil field valve parts, chemical process equipment, aircraft fittings, fasteners, pump shafts, nuclear reactor components, gears, paper mill equipment, missile fittings and jet engine parts. * High temperature application – it is suited up to 350°C, just for short time it can be used maximum 50°C below the precipitation hardening temperature. * Application with condition H900 (PH at 482°C) – this heat treatment provides high tensile strength and high hardness for application where wear resistance is needed with good corrosion properties. It is not suited for subzero application. * Application with condition H1150 (PH at 621°C) – this heat treatment provides very high impact strength so the steel can be used up to -80°C. * Application with condition H1150D (double PH at 621°C) – steel can be used up to -196°C, with good corrosion resistance.
		P1070	ASTM A564/A564M ASTM F899 EN 10088-3			
		P930	EN 10088-3 EN 10250-4			
		DH1150	ASTM A564/A564M ASTM A484/A484M ASTM F899-12b AMS 5643 EN 10204			
		M1150M	EN 10088-3 EN 10250 ASTM A564/A564M			
		UNS S17400	ASTM A564/A564M ASTM A484/A484M ASTM A705/A705M EN 10088-3 AMS 5643			
SINOXX^{***} SINOXX 4545	1.4545	X5CrNiCu15-5 15-5 PH N701	EN 10088-3 AMS 5622 AMS 5659 ASTM A564/564M	Solution annealed + precipitation hardened	Martensitic precipitation hardened	It can be used for a variety of applications including oil field valve parts, chemical process equipment, aircraft fittings, fasteners, pump shafts, nuclear reactor components, gears, paper mill equipment, missile fittings and jet engine parts. * High temperature application – it is suited up to 350°C, just for short time it can be used maximum 50°C below the precipitation hardening temperature. * Application with condition H900 (PH at 482°C) – this heat treatment provides high tensile strength and high hardness for application where wear resistance is needed with good corrosion properties. It is not suited for subzero application. * Application with condition H1150 (PH at 621°C) – this heat treatment provides very high impact strength so the steel can be used up to -80°C. * Application with condition H1150D (double PH at 621°C) – steel can be used up to -196°C, with good corrosion resistance.
		UNS S15500	ASTM A564/A564M ASTM A484/A484M AMS 5659			
		XM-12	ASTM A705/705M AMS 5629			
SINOXX^{***} SINOXX 4546	1.4546	AISI 347H SA-182	ASTM A276/A276M ASTM A479/A479M ASTM A484/A484M AMS 5646	Solution annealed / Quenched	Austenitic	High temperature gaskets and expansion joints, rocket engine parts, aircraft collector rings and exhaust manifolds and chemical production equipment. Component parts for the textile, food processing, paper, chemical and leather industry.
SINOXX^{***} SINOXX 4548	1.4548	X5CrNiCuNb17-4 X5CrNiCuNb17-4-4 17-4 PH N700 T700	EN 10088-3 ASTM F899 ASTM A564-13 AMS 5643 ASTM A564/A564M	Solution annealed + precipitation hardened	Martensitic precipitation hardened	It can be used for a variety of applications including oil field valve parts, chemical process equipment, aircraft fittings, fasteners, pump shafts, nuclear reactor components, gears, paper mill equipment, missile fittings and jet engine parts. * High temperature application – it is suited up to 350°C, just for short time it can be used maximum 50°C below the precipitation hardening temperature. * Application with condition H900 (PH at 482°C) – this heat treatment provides high tensile strength and high hardness for application where wear resistance is needed with good corrosion properties. It is not suited for subzero application. * Application with condition H1150 (PH at 621°C) – this heat treatment provides very high impact strength so the steel can be used up to -80°C. * Application with condition H1150D (double PH at 621°C) – steel can be used up to -196°C, with good corrosion resistance.

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SINOXX ^{***} SINOXX 4550	1.4550	X6CrNiNb18-10	EN 10088-3 EN 10222-5 EN 10250-4	Solution annealed / Quenched	Austenitic	High temperature gaskets and expansion joints, rocket engine parts, aircraft collector rings and exhaust manifolds and chemical production equipment. Component parts for the textile, food processing, paper, chemical, and leather industry.
		AISI 347H	ASTM A182/A182M ASTM A276/A276M ASTM A479/A479M ASTM A484/A484M AMS 5646			
SINOXX ^{***} SINOXX 4571	1.4571	AISI 316Ti	ASTM A182/A182M	Solution annealed / Quenched	Austenitic	SINOXX 4571 is used in the construction of apparatus for the chemical and pharmaceutical industries, adn for textile finishing. Component parts for the cellulose, paper, textile, paint, rubber and meat processing industry and for pump components. Steel grade with lower polishability.
		X6CrNiMoTi17-12-2	EN 10088-3 EN 10250-4 EN 10222-5			
SINOXX ^{***} SINOXX 4773	1.4773	X8Cr30	DIN 17145	Soft annealed	Heat Resistant Steel	Addition material for welding acc. to DIN 8556-1, electrodes for salt baths.
SINOXX ^{***} SINOXX 4910	1.4910	X3CrNiMoBN17-13-3	EN 10088-3 EN 10269 EN 10302 EN 10222-5 EN 10272 SEW 390	Solution annealed / Quenched	Austenitic	Applications: High-voltage electrical apparatus, Bolts and nuts, Transformer tank, generator, preparation equipments, chemical industry, electronic equipment, crude oil and petrochemical industries, medical and pharmaceutical industry.
SINOXX ^{***} SINOXX 4980	1.3980	X5NiCrTiMoV26-15	SEW 390	Solution annealed + precipitation hardened	Austenitic precipitation hardened	Used as a steel for aviation and power engineering for heavy-duty rotors, gas turbine blades, steam turbines, pressure equipment parts and reactors, jet engines and rockets, exhaust systems. Also used in cryogenics and cryotechnics.
	1.4980	X6NiCrTiMoVB25-15-2 X5NiCrTiMoV26-15 A286 AISI 660 UNSS66286	EN 10269 EN 10302 EN 10088-3 ASTM A638/A638M AMS 5732			
SINOXX ^{***} SINOXX E880	-	1CH13N3	GOST 5632-72	Quenched + tempered	Martensitic	This steel is used in power generation. The steel is similar to AISI410 but with added Ni.
SINOXX ^{***} SINOXX S370	-	10X15H9C3Б1-Ш/ 10Ch15N9S3B1	GOST 5632-72	Solution annealed / Quenched	Austenitic	Applications: For the production of forgings, free forging manufactured, semi rental (sheets, rods, ribbons), pipe blanks, pipes and forgings for the manufacture of parts and assemblies of power plant equipment (parts and units of steam generators in power machinery and corrosion resistant to work in a steam environment and corrosion in liquid Pb and Pb-Bi cooling). Maximum operating temperature of 550 °C.
SINOXX ^{***} SINOXX S490	-	B8S	ASTM A193/A193M	Solution annealed / Quenched	Austenitic	Nitronic 60 is truly an all-purpose metal. This fully austenitic alloy was originally designed as a temperature alloy, and subsequently has good high temperature properties. The oxidation resistance of Nitronic 60 is similar to Type 309 S.S., and far superior to Type 304S.S. This grade is best known for its wear and galling resistance. Applications: fasteners, pins and bushings, wear rails, roller bearings, pump components, automotive valves, fastener galling, pins, marine shafts, pin and hanger expansion joints for bridges.
		UNS S21800	ASTM A276/A276M ASTM A479/A479M ASTM A484/A484M ASTM A193/A193M			
		Nitronic 60	ASTM A276/A276M ASTM A479/A479M ASTM A484/A484M AMS 5848			
SINOXX ^{***} SINOXX S690	-	Nitronic 50 UNS S20910	ASTM A276/A276M ASTM A479/A479M	Solution annealed / Quenched	Austenitic	Applications: valves fittings (particular stems due to the excellent alloy toughness), marine applications (include rod rigging using cold drawn lengths, tie-downs and fittings), pump shafts, sucker rods for oil rigs, fasteners, chemical plants, spent nuclear fuel containers (casks), heat exchanger components, structural components.
		XM-19	ASTM A182/A182M ASTM A240/A240M ASTM A276/A276M ASTM A479/A479M ASTM A484/A484M			

↳ DIMENSIONAL RANGE



Rolled bars:

ROUND: \varnothing 7-105 mm, SQUARE: 25-75 mm, FLAT: 40-150 mm width with 7-65 mm thickness, 150-255 mm width with 7-50 mm thickness.

Length: 3000-6000 mm. PEELED&POLISHED: \varnothing 16-80 mm, length: 2500-6000 mm.

GROUND&POLISHED: \varnothing 7-80 mm, length: 2000-4000 mm.

Forged bars:

ROUND: \varnothing 90-950 mm, length: 2000-10000 mm. FLAT: from 80x70 mm to 260x120 mm or 261x80 mm to 1600x550 mm.

SQUARE: 80-850 mm. Length for flat and square: 2000-7000 mm.

Surface:

Black, sandblasted, milled, peeled, turned, ground.

Additional offer:

We also supply different open-die machined forgings and round profiles for various industry sectors (aerospace, oil&gas, energy, mechanical engineering, automotive, etc.)

↳ BENEFITS

Find out the benefits of special steels made according to VOD process from a classically cast ingot in comparison with continuous casting:

- possibility for the production of larger forging blocks, also from a 40 ton ingot,
- higher rate of hot forming, with better mechanical properties, finer grains and a homogeneous microstructure throughout the whole product section,
- option to use EAF+VOD+ESR material with an even better micropurity, lower micro segregations and better mechanical properties,
- products made from these steels have a longer life period under extreme operation conditions of final product, in particular due to a higher stability of material. You will enjoy lower cost of material and, which is the most important: satisfied customers!

↳ DISCLAIMER

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