

VOD STEEL

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.

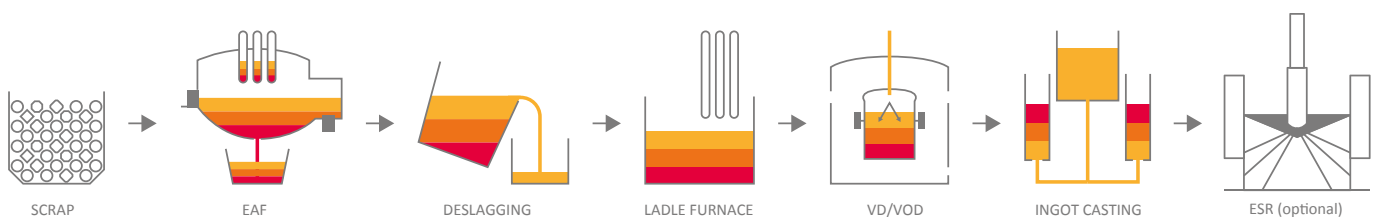


Fig.1: The process of production for a classically cast ingot produced by VOD method and optional ESR remelted

➤ 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.	AISI/ GOST/others	Standard	Heat treatment	Max. round (mm/ inch)	Max. square (mm/ inch)	Max. flat (mm/inch)	Type of stainless steel
SINOXX^{***} SINOXX 4542 SINOXX 4548 SINOXX 4545	1.4542 1.4548 1.4545	17-4PH 17-4PH 15-5PH	EN 10088-3, ASTM A564, AMS 5643V,	Solution annealed	406 / 16	406 / 16	406x305 / 16x12	Martensitic precipitation hardened
			ASTM A705, ASTM 5622F, ASTM 5659L, EN 10088-3, ASTM A564, ASTM A5643V	Solution annealed + precipitation hardened	685 / 27	610 / 24	812x508 / 32x20	
			MS-BSA174HH1150 Re.7 HH1150, H1150D	Solution annealed + precipitation hardened (620°C+620°C)	152/6	152/6	152x127 / 6x5	
			NACE MR175, ASTM A564 H1150D	Solution annealed + precipitation hardened (620°C+620°C)	356/14	356/14	356x305 / 14x12	
			NACE MR175, ASTM A564 H1150M	Solution annealed + precipitation hardened (760°C + 620°C)	356/14	356/14	356x305 / 14x12	
			IMS Spec. N° 17401 Rev.0 H1150M	Solution annealed + precipitation hardened (760°C + 620°C)	150 / 4	150 / 4	100 x 75 / 4 x 3	
			No standard (annealed 650°C)	Soft annealed	685 / 27	610 / 24	812x508 / 32x20	
SINOXX^{***} SINOXX 4313	1.4313	F6NM	EN 10088-3	Hardened + tempered	610/ 24	610 / 24	685x610 / 27x24	Martensitic
			EN 10088-3	Soft Annealed	1016 / 40	865 / 34	812x685 / 32x27	
SINOXX^{***} SINOXX 4401	1.4401	AISI 316	EN 10088-3, ASTM A182	Solution annealed / Quenched	610 / 24	610 / 24	1220x406 / 48x16	Austenitic
SINOXX^{***} SINOXX 4401 SINOXX 4301	1.4401 1.4301	AISI 316 AISI 304	ASTM A182	No heat treatment	685 / 27	660 / 26	1220x406 / 48x16	Austenitic Austenitic
			EN 10088-3, ASTM A182	Solution annealed / Quenched	610 / 24	610 / 24	1220x406 / 48x16	
SINOXX^{***} SINOXX 4305	1.4305	AISI 303	EN 10088-3, ASTM A182	Solution annealed / Quenched	610/ 24	610 / 24	1220x406 / 48x16	Austenitic

* Table shows the maximum dimensions that can be produced at SIJ Metal Ravne according to listed standards; for bigger dimensions, a review is necessary.

SIJ GRADE	W.Nr.	AISI/ GOST/others	Standard	Heat treatment	Max. round (mm/ inch)	Max. square (mm/ inch)	Max. flat (mm/inch)	Type of stainless steel
SINOXX^{***} SINOXX 4550	1.4550	AISI 348	EN 10088-3, ASTM A182	Solution annealed / Quenched	610 / 24	610 / 24	1220x406 / 48x16	Austenitic
SINOXX^{***} SINOXX 4541	1.4541	AISI 321	EN 10088-3, ASTM A182	Solution annealed / Quenched	610 / 24	610 / 24	1220x406 / 48x16	Austenitic
SINOXX^{***} SINOXX 3952	1.3952	/	SEW 390, WL, EN 10088-3, EN 10302, EN 10269 AD2000-W2	Solution annealed / Quenched	610 / 24	610 / 24	1220x406 / 48x16	Austenitic
SINOXX^{***} SINOXX 5490	/	Nitronic 60 S21800	ASTM A240/A240M ASTM A479/A479M	Solution annealed / Quenched	610 / 24	610 / 24	610x508 / 24x20	Austenitic
SINOXX^{***} SINOXX 5690	/	NITRONIC 50 XM-19 S20910	ASTM A276	Solution annealed / Quenched	610 / 24	610 / 24	610x254 / 24x10	Austenitic
SINOXX^{***} SINOXX 4980	1.4980	A-286	ESM-8181, Rev. B, ASTM A638	Class A, B, C & D Type 1 & 2	255 / 10	255 / 10	406x203 / 16x8	Austenitic precipitation hardened
SINOXX^{***} SINOXX 4462	1.4462	S32205	ASTM A182/182M 12A, ASME SA182, EN ISO 10088-3	Solution annealed / Quenched	406 / 16	406 / 16	406x203 / 16x8	Duplex (austenitic + ferritic)
SINOXX^{***} SINOXX 4000	1.400	/	EN ISO 10088-3	Soft annealed	406 / 16	406 / 16	610x305 / 24x12	Ferritic
SINOXX^{***} SINOXX 4418	1.4418	/	EN ISO 10088-3	Hardened + tempered	356/14	356/14	356x305 / 14x12	Martensitic
SINOXX^{***} SINOXX E790	/	10CH11N20T3R	Ae 4115 Dok	Solution annealed + aged	76 / 3	76 / 3	76 x 51 / 3 x 2	Austenitic precipitation hardened

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➤ 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

The information and data presented herein are typical or average values and are not a guarantee of the maximum or minimum values. Applications specifically suggested for material described herein are made solely for the purpose of illustration to enable the reader to make his own evaluation and are not intended as warranties, either express or implied, of fitness for these or other purposes. There is no representation that the recipient of this literature will receive updated editions as they become available.

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