utp maintenance
by voestalpine

Tailor-Made Protectivity™

Repair and Maintenance Weld Overlay Solutions for Steel Mills

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.


utp maintenance

UTP Maintenance

Tailor-Made Protectivity™

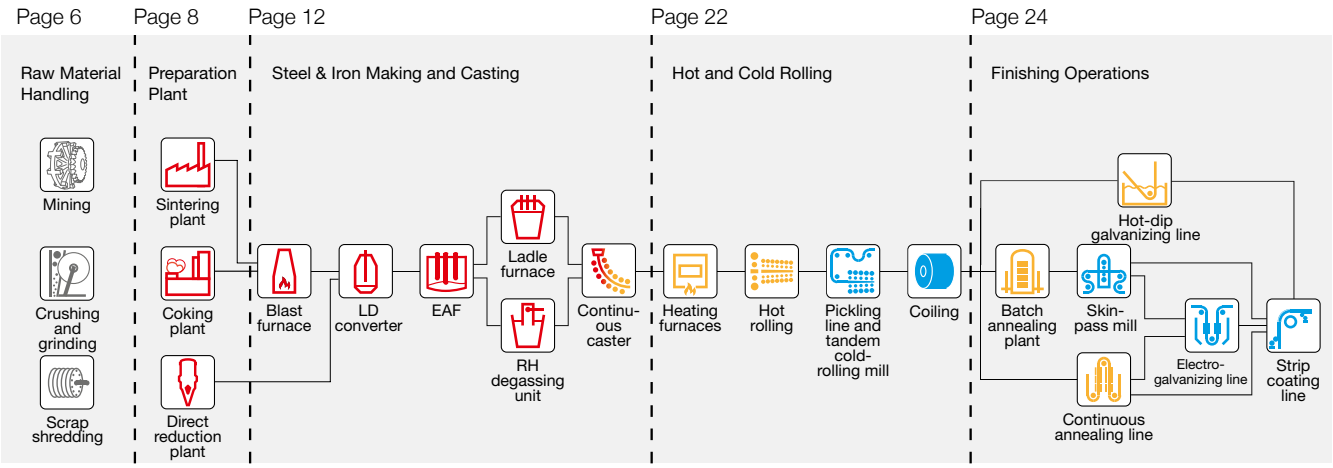
UTP Maintenance guarantees its customers the ideal combination of productivity and protection via innovative and tailor-made products – anywhere in the world. This central theme of Tailor-Made Productivity puts the customer and partner in the center of all activities in order to always optimally fulfill even the most special requirements.

UTP Maintenance offers the best repair, anti-wear and cladding product solutions for the local and global challenges of their customers. UTP Maintenance operates with local specialists and they are closely linked to our global industry managers and application engineers.

With the largest number of application engineers, with the deepest metallurgical and repair, anti-wear and cladding process know-how, UTP Maintenance ensures that the branded products are used to the fullest satisfaction of their customers. All UTP Maintenance branded products are constantly controlled by the voestalpine Böhler Welding certified laboratories.

UTP Maintenance focuses exclusively on its core areas repair, anti-wear and cladding. Thus, the customer application is always in the center of UTP Maintenance activities. UTP Maintenance focuses on the customers, service partners and distributors needs.

voestalpine blast furnace, Linz, Austria



We are at Home in Steel Mills

As a division of specialty steel maker voestalpine, we feel at home when it comes to steel production and the typical wear systems steel mill equipment is subjected to. At voestalpine Böhler Welding, we overlook the full steel manufacturing process – from raw material handling up to continuous casting and finishing operations – and offer tested maintenance and repair solutions for every individual piece of equipment with its own typical wear mechanism.

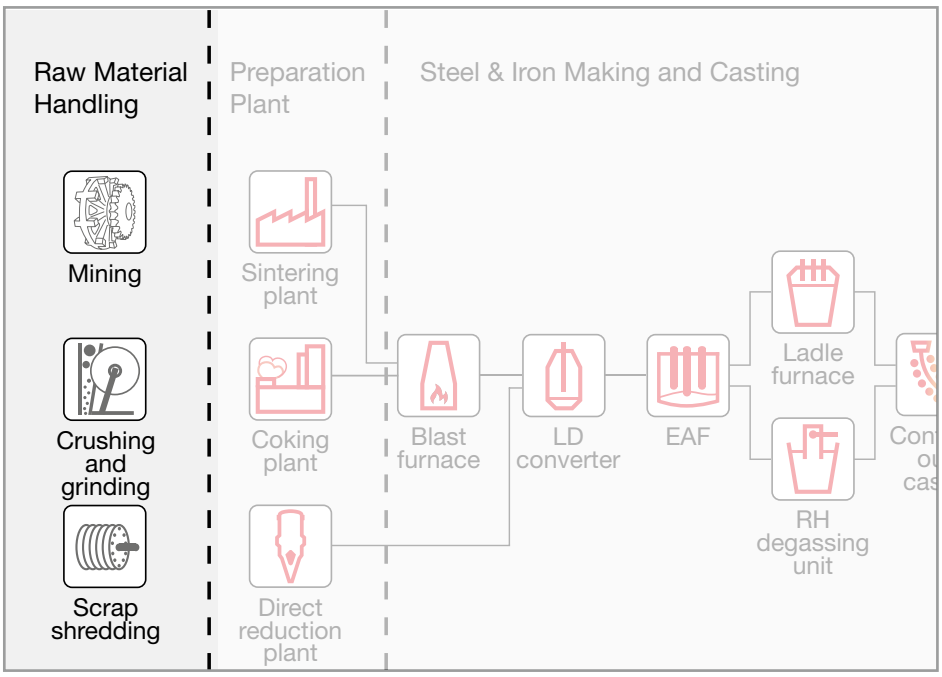
Our solutions for steel mills are based on European technology and are fully developed by our two specialized units in Seneffe, Belgium and Bad Krozingen, Germany, where we have well equipped test centers and chemical and metallurgical laboratories at our disposal. Our products, all marketed under the UTP brand name, are developed and tested in close co-operation with voestalpine and other steel mills across the globe and cover all commonly applied welding processes used in the maintenance and repair of steel mill equipment.

We offer one, two and three layer solutions for the repair of continuous casting rollers with properties optimized for the various wear systems occurring along the line. Next to the steel mills themselves, we co-operate with manufacturers of continuous casting lines and with technical universities.

We are at home in steel mills. Our specialized engineers and technicians share their expertise and support you on site with the selection and implementation of tailor-made and productive repair and maintenance solutions and train your staff to apply them in the most effective way.

UTP Maintenance
Tailor-Made Protectivity™

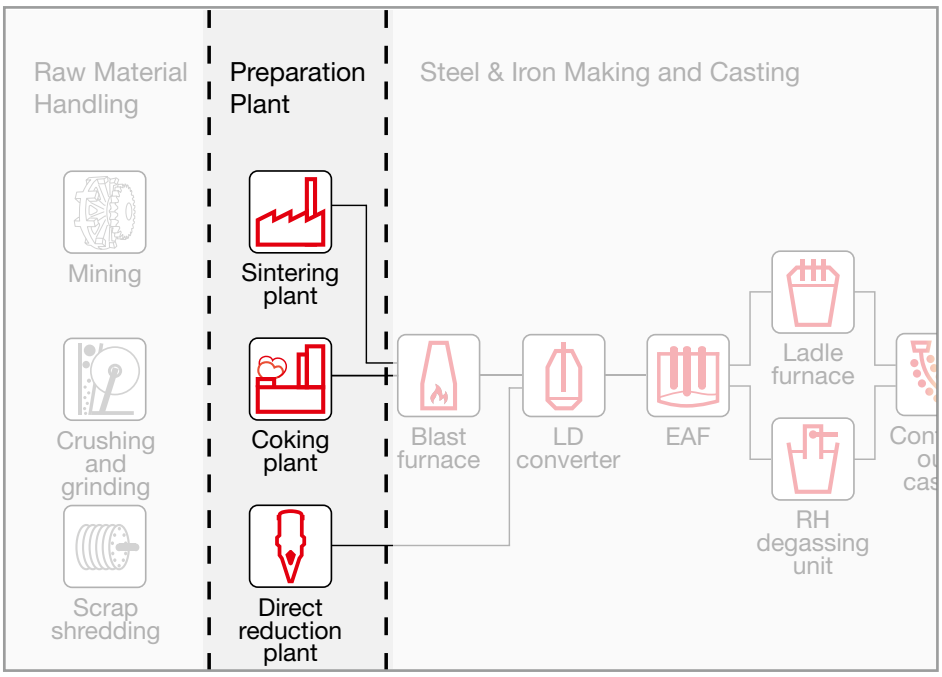
Raw Material Handling



Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Wear plates	Abrasion		**Cored wires**		
	High temperatures		SK 162-O	63 HRC	Austenitic matrix with Cr carbides
	Impact		SK 867 WP-O	62 HRC	Austenitic matrix with Cr carbides
	Corrosion		SK A43-O	64 HRC	Austenitic matrix with Cr and Nb carbides
	Metal to metal		SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
Scrap shredders	Abrasion		**Cored wires**		
	High temperatures		SK AP-O	205HB/50HRC**	Austenite
	Impact		SK A43-O	64 HRC	Austenitic matrix with Cr and Nb carbides
	Corrosion		**Stick electrodes**		
	Metal to metal		UTP BMC	260HB/50HRC**	Austenite
			UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.
** After work hardening

Preparation Plant



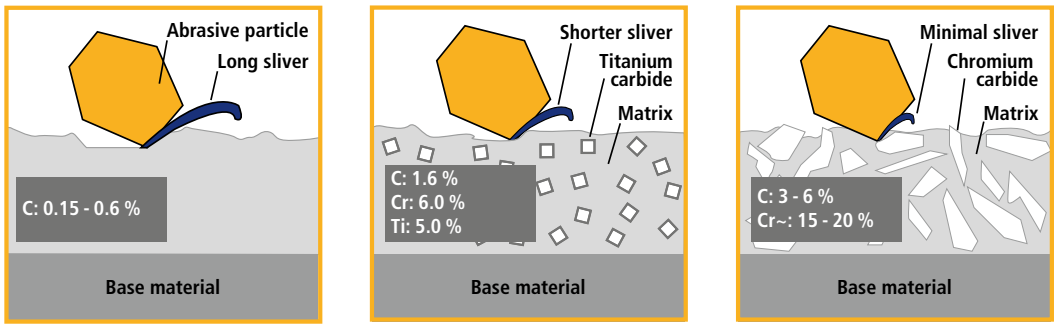
Iron ore and coal handling

Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Raw material mixing	Abrasion		**Cored wires**		
	High temperature		SK 900 Ni RTC-O/G	Matrix: 50 / 44 HRC W-carbides: 3000 HV	Austenitic NiBSi matrix with tungsten carbides.
	Impact				
	Corrosion		SK ABRA-MAX O/G	70 HRC	Homogeneously dispersed complex carbo-borides and borides
	Metal to metal				
Sinter breaker	Abrasion		**Cored wires**		
	High temperature		SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Impact		SK A83-OSP	62 HRC	Austenitic cast iron with complex carbides
	Corrosion		**Stick electrodes**		
	Metal to metal		UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
Sinter bars	Abrasion		**Cored wires**		
	High temperature		SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Impact		SK A83-OSP	62 HRC	Austenitic cast iron with complex carbides
	Corrosion		**Stick electrodes**		
	Metal to metal		UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
Exhaust fans	Abrasion		**Cored wires**		
	High temperature		SK 402-O	200 HB	Austenite
	Impact		SK A 43-O	64 HRC	Austenitic cast iron with Cr and Nb carbides
	Corrosion		SK A 45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Metal to metal		SK ABRA-MAX O/G	70 HRC	Homogeneously dispersed complex carbo-borides and borides
			SK A 43-OB	65 HRC	Austenitic cast iron with Cr and Nb carbides
			Stick electrodes		
			UTP 63	180 HB	Austenite
			UTP Abrasodur 43+	63 HRC	Austenitic cast iron with Cr and Nb carbides
			UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

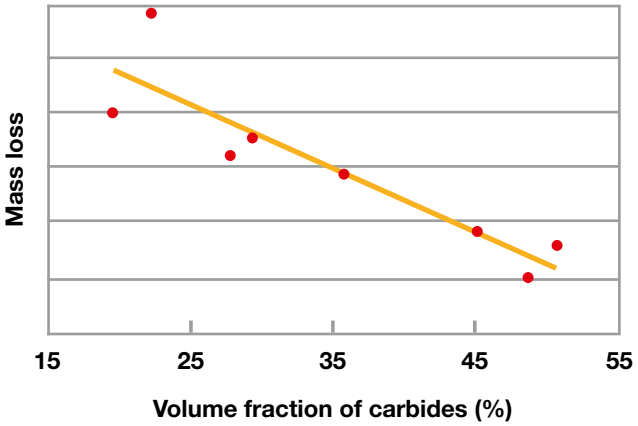
Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Sinter grinding	Abrasion		**Cored wires** SK 900 Ni RTC-O/G	Matrix: 50 / 44 HRC W-carbides: 3000 HV	Austenitic NiCrBSi matrix with tungsten carbides.
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Sinter wagon	Abrasion		**Cored wires** SK FNM4-G	140 HB	Austenitic FeNi alloy
	High temperature		**Solid wire** UTP A 8051 Ti	200 HB	Ferritic & austenitic nodular cast iron
	Impact		**Stick electrodes** UTP 86 FN	220 HB	Austenitic FeNi alloy
	Corrosion				
	Metal to metal				
Direct reduction of iron	Abrasion		**Cored wires** UTP AF 068 HH SK A 45-O	180 HB 63 HRC	Austenitic NiCr alloy Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	High temperature				
	Impact		**Stick electrodes** UTP 068 HH UTP LEDURIT 65	180 HB 65 HRC	Austenitic NiCr alloy Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Corrosion				
	Metal to metal				

Abrasion Resistance Requires Presence of Carbides



Increasing quantities of carbide formers : C, Cr, Ti, Nb, Mo, V, W

Abrasion resistance not only depends on the overall hardness level, but also on shape, size and volume fraction (density) of carbides. As carbides are harder than the matrix, they slow down wear of the matrix by abrasive particles. The higher the volume fraction of carbides, the better the abrasion resistance.



Single layer solution for hardfacing

SK 900 Ni RTC-G is a unique gas shielded cored wire for the hardfacing of components which are subjected to extreme abrasive wear in combination with wet corrosion. Already in the first layer, the weld metal generates sufficient amounts of carbides in the matrix to achieve good abrasion resistance for many practical applications. The nickel base matrix also provides excellent corrosion resistance in wet environments. The diagram compares abrasion wear resistance according to the ASTM G65 method with a traditional gas-shielded cored wire, SK 900 Ni-G. For both wires, Ar + 2 % O_2 shielding gas was used in the standard MIG process and the Cold Metal Transfer MIG process. Lowest weight loss with a single layer is obtained, using SK 900 Ni RTC-G with the CMT process.

In general, the single layer solution provides substantial savings in overlay time and welding consumables.

SK 900 Ni RTC-G : abrasion with Al_2O_3, metal losses in gr. according to ASTM G65.

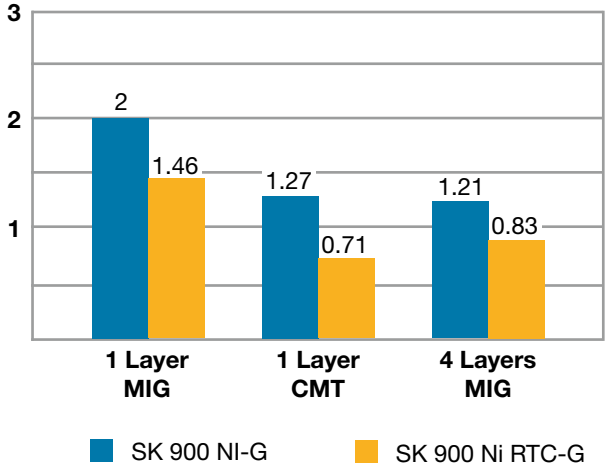
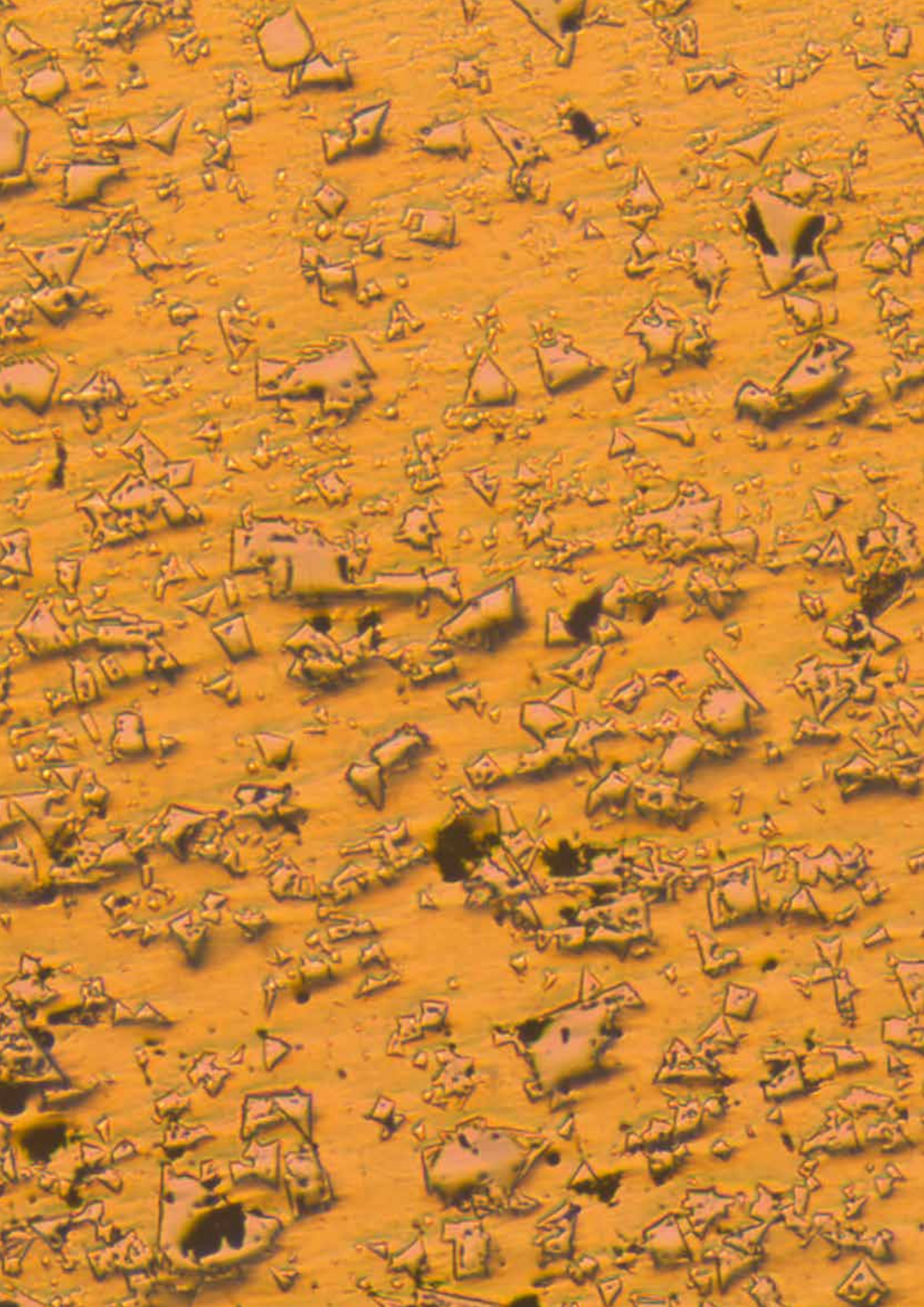
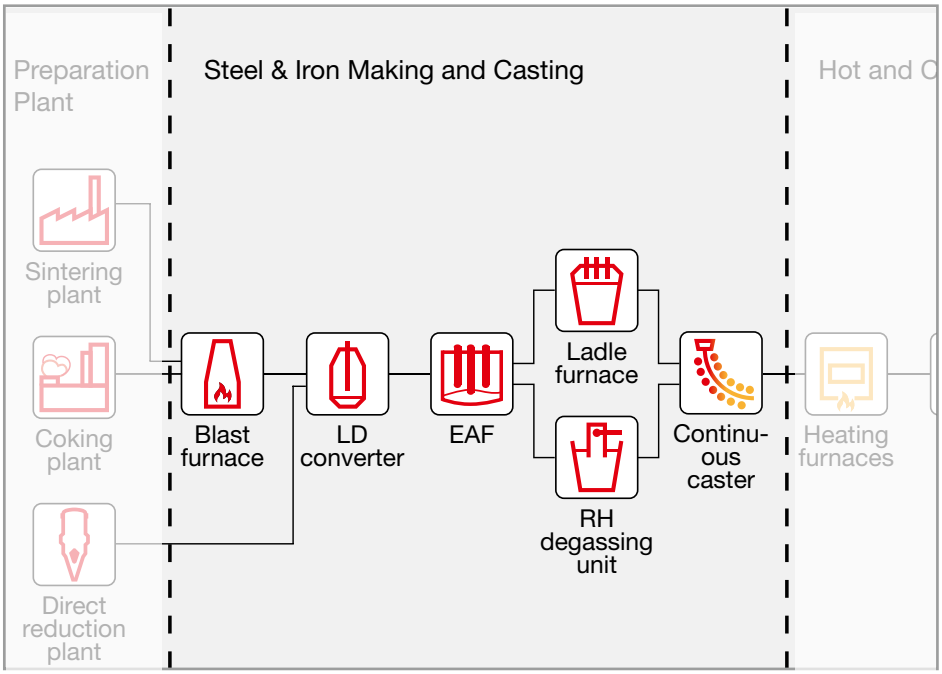


Photo right hand page: Tungsten carbides in NiCrSiB matrix



Steel & Iron Making



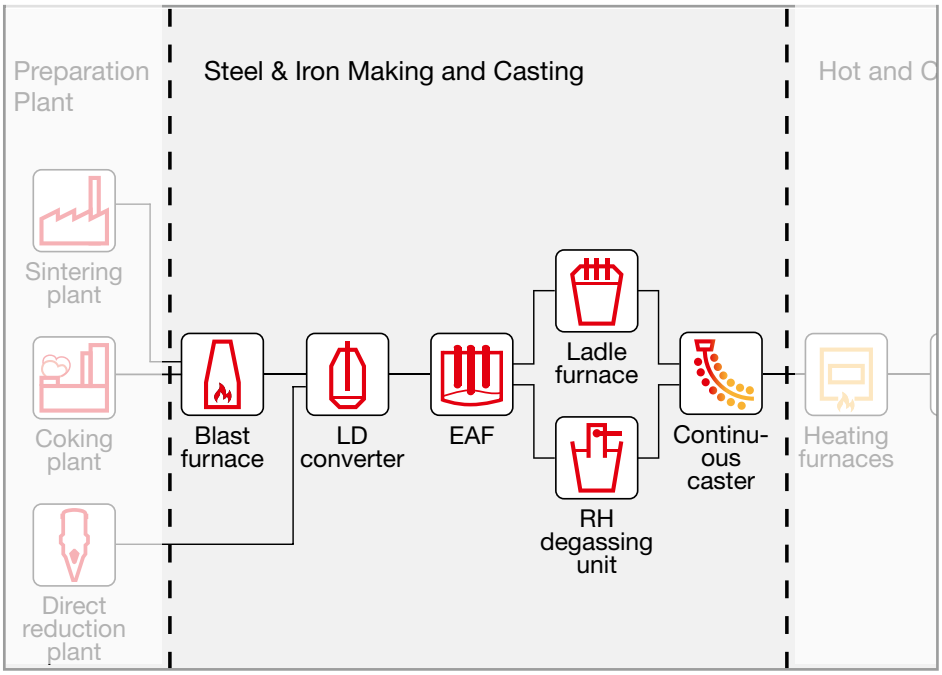
Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Blast furnace bell	Abrasion		**Cored wires** SK 309L-O SK 258L-O/SA SK A43-O/S	 170 HB 44 HRC 64 HRC	 Austenite + Ferrite Martensite Austenitic matrix with Cr and Nb carbides
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Rotating chutes	Abrasion		**Cored wires** SK A45-O SK A83-OSP	 63 HRC 62 HRC	 Austenitic matrix with Cr, Nb, Mo, W and V complex carbides Austenite + Co + complex carbides
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Hot air blowing nozzles	Abrasion		**Cored wires** SK 089-O SK GS-O **Solid wire** UTP A 38 **Stick electrodes** UTP 39 UTP 5D	 50 HRC 220 HB 60 HB 60 HB 220HB	 Lamellar grey cast iron Spheroidal graphite cast iron Pure copper Pure copper Spheroidal graphite cast iron
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Ladle transportation	Abrasion		**Cored wires** SK 350-G SK 450-G SK 258L-SA SK 242-S UTP A ROBOTIC 352 UTP AF ROBOTIC 405 **Stick electrodes** UTP DUR 350	 330 HB 47 HRC 44 HRC 40 HRC 350 HB 48 HRC 370 HB	 Bainite Martensite Martensite Martensite Martensite Martensite Bainite
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Slag pots	Abrasion		**Cored wires** SK Soudocore S8-O	 190 HB	 Ferrite
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				

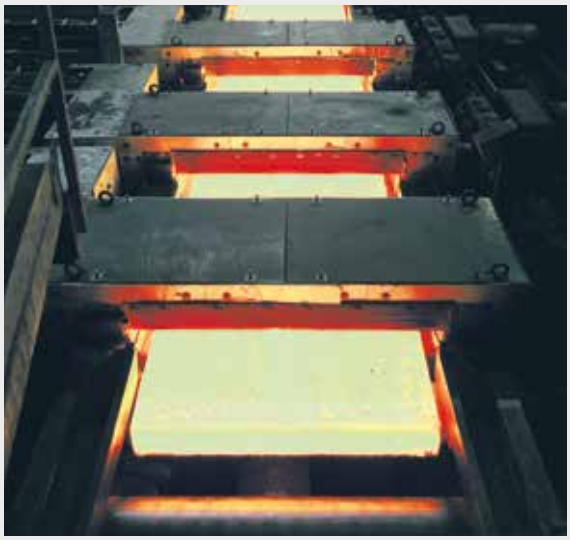
* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Electric arc furnace	Abrasion		**Cored wires**		
	High temperature		UTP AF 6222 Mo PW-FD UTP AF 068 HH-FD	220 HB 180 HB	Austenitic NiCrMo alloy Austenitic NiCr alloy
	Impact		**Stick electrodes**		
	Corrosion		UTP 6222Mo UTP 068 HH	220 HB 180 HB	Austenitic NiCrMo alloy Austenitic NiCr alloy
	Metal to metal				
Basic oxygen convertor	Abrasion		**Cored wires**		
	High temperature		SK 350-G SK 450-G SK 258L-SA SK 242-O/S SK 252-O/S SK AP-O/S UTP A ROBOTIC 352 UTP AF ROBOTIC 405	330 HB 47 HRC 44 HRC 40 HRC 44-46 HRC 205HB/50HRC 350 HB 48 HRC	Bainite Martensite Martensite Martensite Martensite Austenite Martensite Martensite
	Impact				
	Corrosion				
	Metal to metal				
BOF scrap charging chute	Abrasion		**Cored wires**		
	High temperature		SK 258 TiC-O SK 650-G SK 255-O	58 HRC 58 HRC 60 HRC	Martensitic + Ti carbides Martensite Austenitic matrix + Cr carbides
	Impact				
	Corrosion				
	Metal to metal				
Fume exhaust pipes	Abrasion		**Cored wires**		
	High temperature		SK 256-O SK OXY-M	63 HRC –	Austenitic matrix + Cr carbides Cermets
	Impact				
	Corrosion				
	Metal to metal				
Converter chimney	Abrasion		**Cored wires**		
	High temperature		SK 830-MF SK 840-MF SK OXY-M	– – –	Ni-Si-B multiphasic microstructure Ni-Cr-Si-B multiphasic microstructure Cermets
	Impact				
	Corrosion				
	Particle erosion				

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

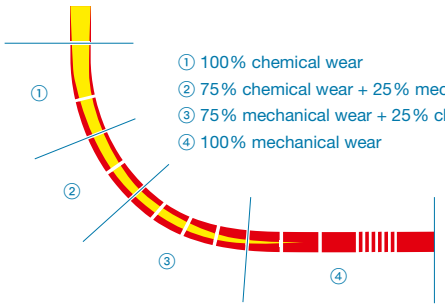
Continuous Casting



Component	CC zone	Recommended consumables*	Hard-ness	Microstructure
Continuous casting		**Cored wires**		
	1	SK 768-G/S SK 741-O/G SK 410 NiMo-SA SK 370-O	35 HRC 41 HRC 39 HRC 42 HRC	Supermartensitic Martensite + 10% Ferrite Martensite + 10% Ferrite Martensite + 10% Ferrite
	2	SK 415-SA SK 714N-O SK 742N-SK SK 743N SK	42 HRC 44 HRC 44 HRC 45 HRC	Martensite + 10% Ferrite Martensite + Ferrite Martensite + 10% Ferrite Martensite + 5-10% Ferrite
	3	SK 420-SA SK 461C-SA SK 258-SA	53 HRC 54 HRC 57 HRC	Martensite Martensite + Ferrite Martensite
	4	SK 258-O SK 258-SA	55 HRC 57 HRC	Martensite Martensite
	Buffering	SK 430 C-SA SK BU-S SK 20CrMo-SA	175 HB 225 HB 250 HB	Ferrite + Martensite Bainite Ferrite
		Strip-flux combinations		
	1	SOUDOTAPE 430L + RT 168 SOUDOTAPE 430 + RT 152 SOUDOTAPE 430 + EST 453	35 HRC 41 HRC 40 HRC	Supermartensitic Martensite + 10% Ferrite Martensite + 10% Ferrite
	2	SOUDOTAPE 430 + RT 742 SOUDOTAPE 410L + RT 157	40 HRC 45 HRC	Martensite + 10% Ferrite Martensite + Ferrite
	3	SOUDOTAPE 420 + RT 159 SOUDOTAPE 420 + EST 426 SOUDOTAPE 258 + EST 122	55 HRC 50 HRC 55 HRC	Martensite Martensite Martensite
	4	SOUDOTAPE 258 + EST 122 SOUDOTAPE 258 + RT157	55 HRC 50 HRC	Martensite Martensite
	Buffering	SOUDOTAPE A + RT 146 SOUDOTAPE A + SMoTW SOUDOTAPE 430 + RT 179 SOUDOTAPE 430 + EST 127	150 HB 165 HB 200 HB 200 HB	Ferrite Ferrite Ferrite Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Identification of wear modes along a CC line

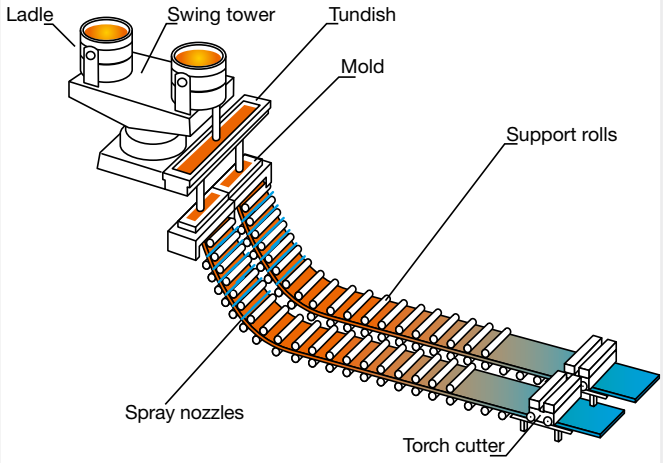


Recommended alloys for overlay

① 13Cr+4Ni+Mo-LC ② 13Cr+Ni+Mo+C
③ 12Cr+Mo+C ④ 5Cr+Mo, W, V

Continuous Casting Rollers

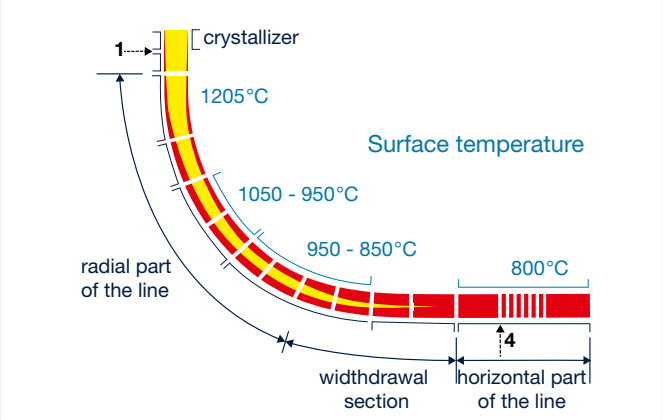
Wear & repair

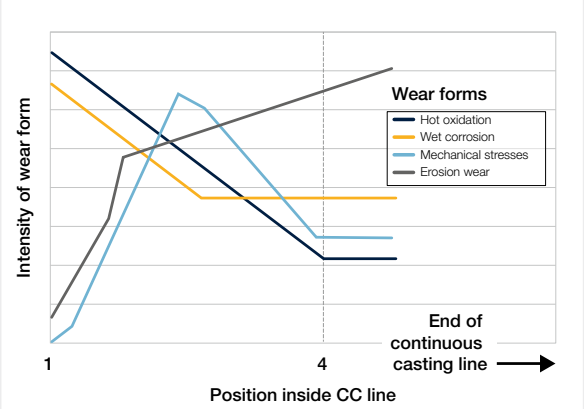


In the continuous slab casting process, caster rollers are utilized for solidification containment, strand support, slab bending and unbending, driving and conveying of the solidifying slab. Dimensional tolerances, mechanical stability and surface condition of the caster rollers affect both the internal and surface quality of the steel slab. A typical continuous casting installation contains 350-700 caster rollers. Common base materials used for the rollers are 42CrMo4, 25CrMo4, 16CrMo44 and 21CrMoV5.11.

To substantially extend the service life of the rollers, their surface is covered with a wear resistant overlay, typically with martensitic stainless steel alloys.

Wear types along the continuous casting line

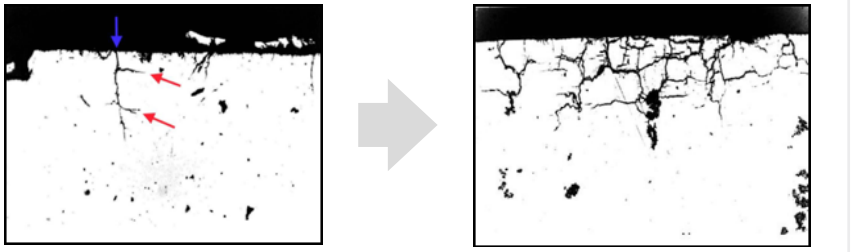




Continuous casting rollers are subjected to varying combinations of rather complex individual wear mechanisms. This leads to rapid deterioration of the rollers when their surface is not properly protected. The type of wear and its intensity depend on the position of the rollers in the continuous casting line as the slab temperature drops and the gravitational force acting on the rollers increases. At the upper part of the line, wet corrosion, thermal shock and resulting fire cracking are predominant. At the lower part of the line, mechanical stresses and metal-to-metal wear progressively play a more significant role.

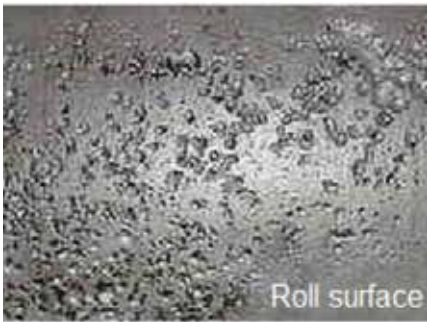
Fire cracking

Fire cracking is the combined result of several degradation processes such as thermal fatigue, hot oxidation, erosion and cyclic bending. Fire cracks have the appearance of shallow surface cracks. Stresses from corrosion, steam erosion, cyclic heat and alternating mechanical loads concentrate at the crack tips and lead to further extension of the network of cracks.

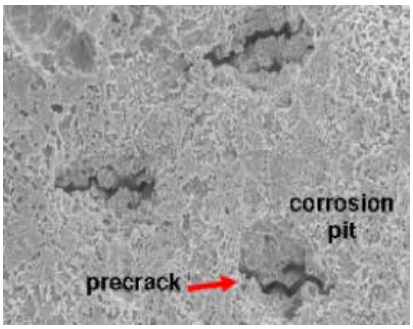


Wet corrosion

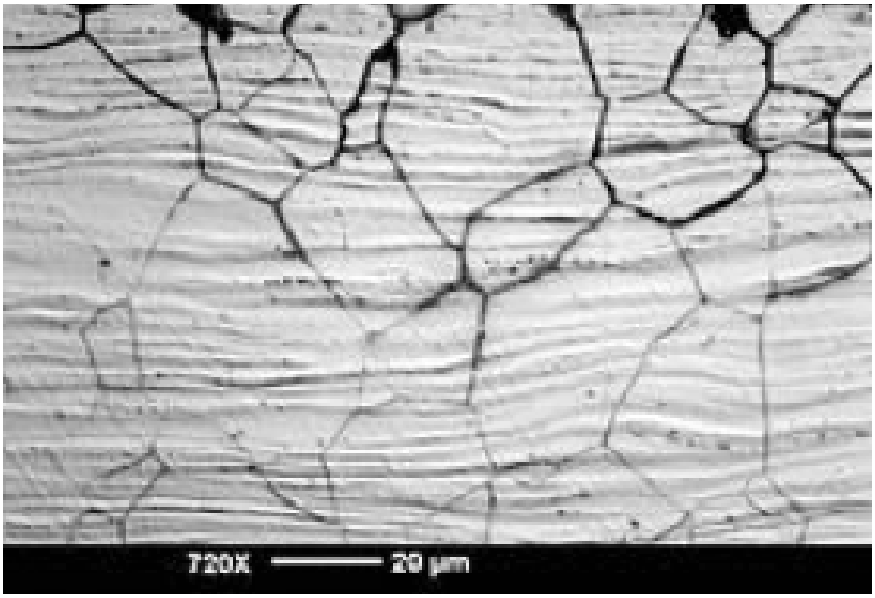
Wet corrosion from cooling water can be caused by a high mineral content in water from local sources or by re-circulated water contaminated with fluorides from ladle insulation powders, tundish cover refractories or from casting powders. The cooling water becomes an aggressive pitting medium, leading to a combination of three main corrosion mechanisms; pitting, intergranular and stress corrosion cracking.



Pitting corrosion on roll surface



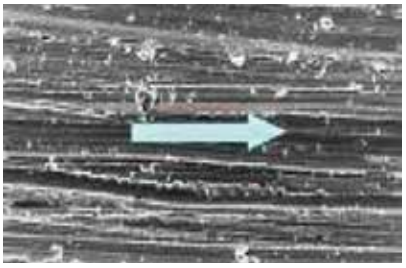
Stress corrosion cracks originating at corrosion pits.

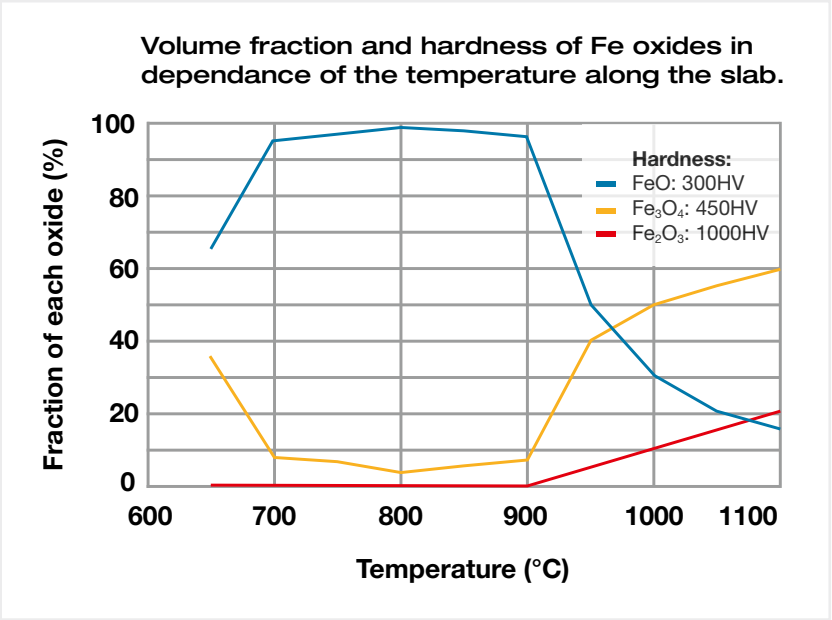


Intergranular corrosion due to chromium carbide precipitation at the grain boundaries

Erosion wear

Surfaces of extremely hot steel oxidize rapidly in air, forming abrasive iron oxides that wear off the surfaces of continuous casting rollers. The exit temperature of the cast slab is in the range where hard and abrasive FeO, Fe_2O_3 and Fe_3O_4 are formed on its surface. The rollers are subjected to abrasive wear by these oxides and by the resulting debris. The intensity of this wear depends on the overall oxides hardness and, therefore, on the volume fraction and individual hardness of the oxide types shown in the diagram below.





Another form of erosive wear is erosion caused by steam formation combined with chloride induced corrosion. Cooling water trapped in surface pits and oxides forms steam bubbles whose pressure breaks off particles from the roll surface.

Overlay of Continuous Casting Rollers

Cladding processes

In most cases, the SAW process with cored wires and mechanized welding with self-shielded cored wires are used for the overlay of continuous casting rollers. Weaving is applied to minimize the number of overlaps between runs, as these may be more sensitive to corrosion. Submerged arc or electroslag strip cladding are also regularly used. These processes feature lower dilution with the base material, wider beads with fewer overlaps and significantly increased deposition rate.

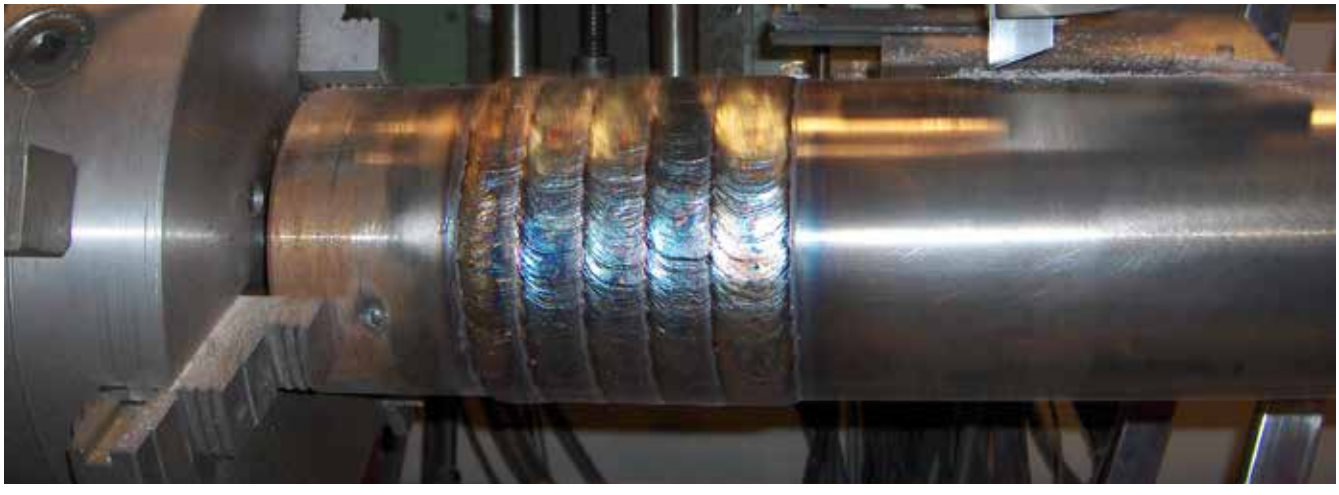
Overlay materials

The most suitable alloys with a good resistance against a combination of wear and corrosion are found in the martensitic stainless steel family. By an appropriate balance between the addition of carbide formers and heat treatment, weld overlays with hardness values between 35 HRC and 55 HRC can be obtained, which have shown a satisfactory behavior in service. The addition of alloying elements has to be carefully controlled to obtain a minimum delta-Ferrite content of 5% to minimize stress corrosion and max. 10 % delta-Ferrite for fatigue strength resistance. Different martensitic stainless steels have been investigated. Alloy type 420 became very popular during the 80-s and 90-s, but nowadays Alloy type 410NiMoNbV is the preferred choice, providing a significant increase in service life of the rollers. Also soft martensitic stainless steels are applied.
UTP Maintenance overlay consumables for continuous casting rollers on page 14 are categorized in the same manner.

Family	Alloy type	Chemical composition, wt %								Hardness
		C	Mn	Si	Cr	Ni	Mo	Nb	V	HRC
Martensitic	410NiMoNbV	0.09	0.25	0.9	13.5	2.4	1	0.15	0.15	54
Soft martensitic	13Cr4Ni1Mo	0.06	0.4	0.9	14	4	0.9	–	–	40 - 45
Super martensitic	12Cr6Ni2Mo	0.017	0.22	1.1	12.9	5.2	2.6	–	–	35

Typical all weld metal chemical compositions of the different martensitic stainless steel types.

A completely new solution for the overlay welding of continuous casting foot rollers is with supermartensitic stainless steel. It is used for the topmost part of the line where thermal shock, corrosion and hot oxidation are most severe, but with still low mechanical wear.



NEW SOLUTION: Supermartensitic weld overlays

At the topmost part of the continuous casting line, thermal shock, corrosion and hot oxidation are most severe, while mechanical wear is still low. For this reason, it is accepted to apply overlay materials with a lower hardness, but with increased corrosion resistance. Supermartensitic stainless steel has a much better corrosion resistance than classic martensitic types combined with acceptable wear behaviour.

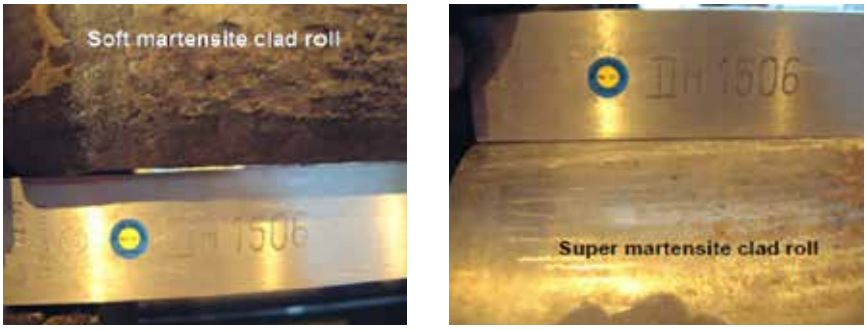
UTP Maintenance has developed two types of overlay materials for the first series of rollers in the vertical section, directly after the mould of the continuous casting process:

- SK 768 G and SK 768 S cored wires of the 12.5Cr-5Ni-2.5Mo type for respectively gas-shielded and submerged arc overlay welding
- SOUDOTAPE 430L / RECORD RT 168 strip / flux combination of the 12.5Cr-5Ni-2.5Mo type for submerged arc strip cladding.

One of the severest corrosion mechanisms taking place here is due to accumulation of fluorine and alkaline casting powders in the cooling water, the so called mould-flux-induced-corrosion. In this area, soft martensitic stainless steel overlays are a commonly applied solution and therefore formed the benchmark in development. The new strip / flux combination was extensively tested at the Dillinger Hütte steel works, in Germany.

Following targets were specified for the properties of the new solution:
- Improved wear resistance in primary roller section.
- Martensite starting temperature far above room temperature to facilitate full transformation
- No influence of dilution with base material in the third layer
- Delta Ferrite content below 10% (point counting method)
- Suitability for small roll diameters, typically 150-300 mm
- Good slag release at temperatures of 300-350°C

Results of laboratory and field tests summarized are:
- The supermartensitic overlay with RECORD RT 168 / SOUDOTAPE 430L doubled the lifetime of the overlaid rollers in the first segment of a continuous casting line.
- The delta Ferrite content in the supermartensitic structure of the third layer can be established below 10%, by applying a fourth "post heating layer".
- Slag self-releasing after only half a turn of 150-160 mm diameter rollers.
- Laboratory and field tests were in full allignment



Comparison of soft and supermartensitic overlaid rollers after long term testing in continuous casting practice.

Universal **single layer** solution for the repair of continuous casting rollers

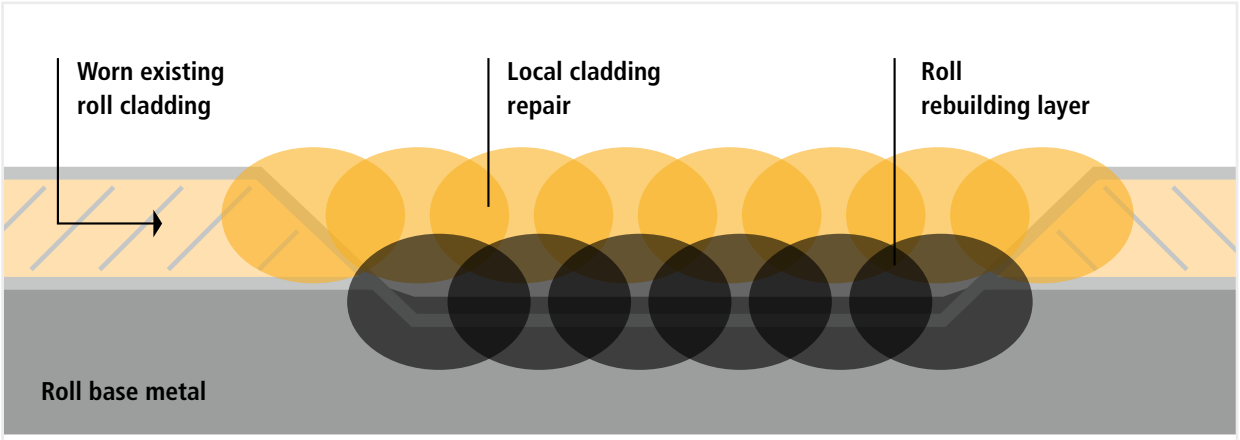
SK 743N-SK / RECORD SK

For steel mills requiring a universal single-layer solution for the repair of rollers over the full length of the continuous casting line, the submerged arc cored wire / flux overlay combination SK 743N-SK / RECORD SK and the open arc cored wire SK 743N-O form a compromise for using several product combinations. The innovative aspect of this combination is that the targeted chemical composition is reached in one single layer when overlaying onto commonly applied creep resistant steel roller materials such as 42CrMo4, 25CrMo4, 16CrMo44 and 21CrMoV5.

This product combination gives a weld metal with a martensitic matrix with 5-10 % Ferrite and a hardness of ~45 HRC after PWHT of 6 hours at 500 °C. Nitrogen is added to enhance resistance to thermal fatigue and intergranular corrosion by reducing the formation of carbides at the grain boundaries.

	C	Mn	Si	Cr	Ni	Mo	Nb	V	N	Fe
All Weld	0.035	0.53	0.6	15.0	2.4	1.0	0.9	0.15	0.1	Bal.

When needed due to excessive wear, rollers can be re-built with the wire / flux combination SK 20CrMo-SA / RECORD SK prior to hard facing with SK 743N-O.



Repair solution with straight beads. Weaved beads also possible.

Universal **multi-layer** solution for the repair of continuous casting rollers

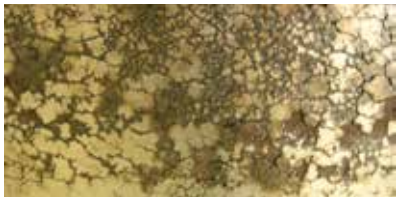
SK 742N-SK / RECORD SK

For steel mills requiring a universal multi-layer solution for the repair of rollers over the full length of the continuous casting line, the submerged arc cored wire / flux overlay combination SK 742N-SK / RECORD SK forms a compromise for using several product combinations. The wire gives a martensitic microstructure and the chemical elements are balanced to provide optimum average resistance to the common wear mechanisms occurring along the line. A minimum of three layers is recommended to reach the desired weld composition in the top layer.

- Hot oxidation (thermal fatigue)
- Wet corrosion from aggressive cooling water contaminant
- Erosive wear caused by steam formation
- Erosive wear caused by oxides formation on the surface of the slab
- Plastic deformation due to mechanical stresses

	C	Mn	Si	Cr	Ni	Mo	Nb	Fe	N
All Weld	0.05	1.2	0.4	13.50	3.30	1.3	0.10	Bal.	0.1

SK 742N-SK /RECORD SK - all weld metal typical chemical composition to be reached in three layers with a total thickness of 10-12 mm.



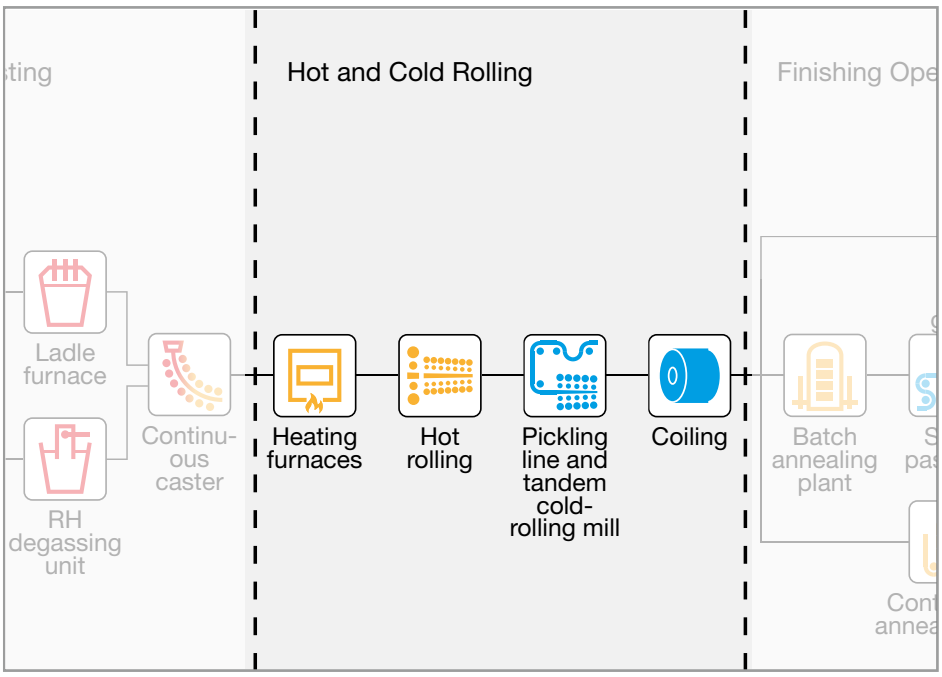
Hot oxidation

Thermal fatigue

Wet corrosion

The combination SK 742N-SK / RECORD SK features excellent weldability with flat beads with smooth overlaps and excellent slag release. It offers the advantage of a repeatable, uniform repair procedure, all along the continuous casting line. The combination is successfully used by major steel works worldwide for many years, with expected life time of reclaimed rollers above 3.5 million tons production output.To increase the deposition rate use our alternative strip / flux combination SOUDOTAPE 430 / RECORD RT 742.

Hot and cold rolling



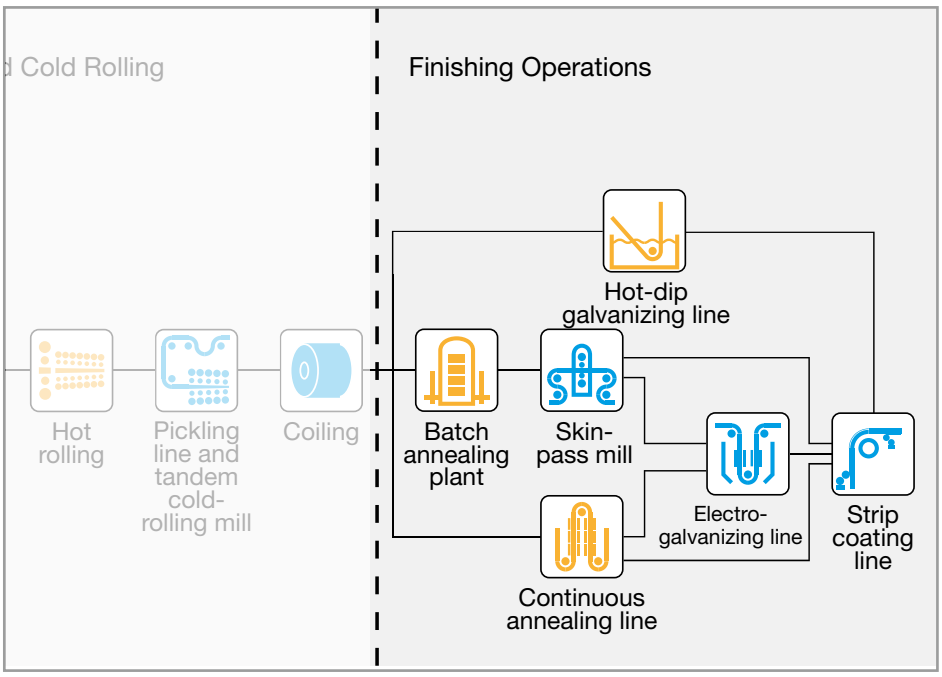
Component	Predominant wear modes	Intensity	Recommended consumables*	Hard-ness	Microstructure
Slab tongs	Abrasion		**Cored wires**		
	High temperature		SK Tool Alloy C-G	~200 HB	Austenite with solid strengthening precipitates
	Impact		SK Tool Alloy Co-G	230 HB	Austenite with solid strengthening precipitates
	Corrosion		SK Stelkay 21-G	32 HRC	Austenite with dispersed Cr and Mo precipitates
	Metal to metal		SK U520 Co-G	190 HB	Austenite with solid strengthening precipitates
			Stick electrodes		
			UTP Celsit 721	37 HRC	Austenite with dispersed Cr and Mo precipitates
Slab scale scraper	Abrasion		**Cored wires**		
	High temperature		SK D12-G	56 HRC	Martensite
	Impact		SK D35-G	50 HRC	Martensite
	Corrosion				
	Metal to metal				
Scale breaker	Abrasion		**Cored wires**		
	High temperature		SK 385-SA	54 HRC	Chromium carbides in a martensitic matrix with residual austenite
	Impact		SK 740-SA	46 HRC	Martensite + 10% Ferrite
	Corrosion		SK 461C-SA	54 HRC	Martensite + max 20% Ferrite
	Metal to metal				
Conveying rolls	Abrasion		**Cored wires**		
	High temperature		SK 650-G	58 HRC	Martensite
	Impact		SK 258-O	55 HRC	Martensite
	Corrosion		SK 258-SA	57 HRC	Martensite
	Metal to metal		SK 385-SA	54 HRC	Chromium carbides in a martensitic matrix with residual austenite
			Strip & flux		
			SOUDOTAPE 420 / RECORD EST 423	54 HRC	Martensite
Hot rolling mills	Abrasion		**Cored wires**		
	High temperature		SK 740-SA	46 HRC	Martensite + 10% Ferrite
	Impact		SK 263-SA	50 HRC	Martensite
	Corrosion		SK 258L-SA	44 HRC	Martensite
	Metal to metal		SK 258 NbC-SA	58 HRC	Martensite + Nb carbides
			SK 461 C-SA	54 HRC	Martensite + max 20% Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Component	Predominant wear modes	Intensity	Recommended consumables*	Hard-ness	Microstructure
Hot rolling mills					
Back-up rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wire** SK 258NbC-SA	57 HRC	Martensite + Nb and W carbides
Bearing chock 	Abrasion High temperature Impact Corrosion Metal to metal		**Strip-flux combi-nation** SOUDOTAPE 430 / RECORD RT 159	230 HB	Martensite + Ferrite
Working rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Strip-flux combi-nation** SOUDOTAPE 430 / RECORD EST 423	52 HRC	Martensite
Edger rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 263-SA SK 461C-SK	50 HRC 54 HRC	Martensite
Coiling					
Pinch rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 742N-SK **Strip-flux combi-nation** SOUDOTAPE 430 / RECORD RT 742	44 HRC 40 HRC	Martensite + 10 % Ferrite
Pinch rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wire** SK 258-SA **Strip-flux combi-nation** SOUDOTAPE 258 / RECORD EST 122	57 HRC 55 HRC	Martensite + carbides
Coiler 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 461C-SA SK 385-SA	54 HRC 54 HRC	Martensite + max. 20% Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Finishing operations



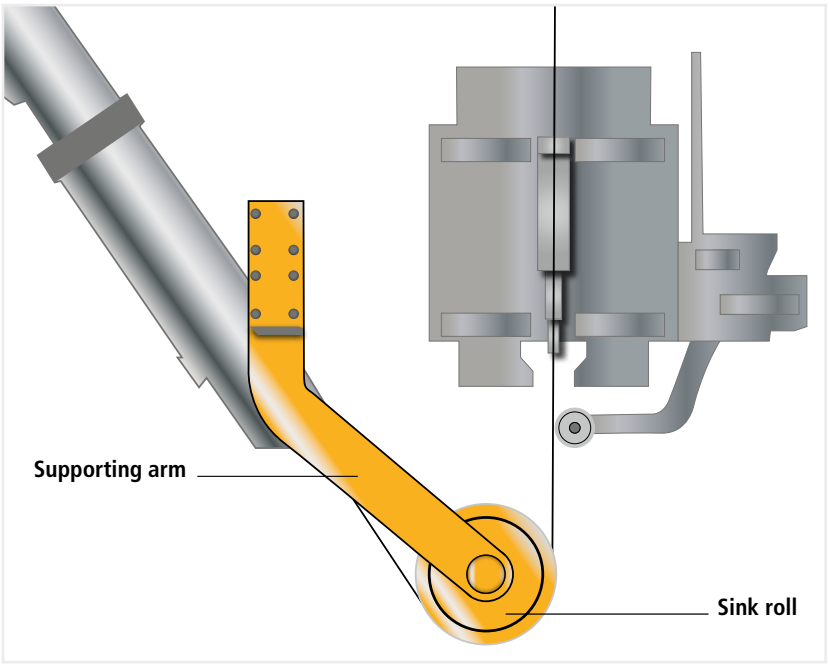
Component	Predominant wear modes	Intensity	Recommended consumables*	EN 14700	Hardness	Microstructure
Gear roll driving shaft 	Abrasion		**Cored wires** SK 228-G SK 258L-G SK 350-G		315 HB 45 HRC 330 HB	Martensite Martensite Bainite
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					
Tension levelers 	Abrasion		**Cored wires** SK 263-SA SK 253NbC-S		50 HRC 51 HRC	Martensite Martensite, little residual austenite and dispersed NbC carbides
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					
Hot dip galvanizing rollers 	Abrasion		**Cored wires** SK ZIP-O		170 HB	Fully austenitic
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

SK ZIP-O for cladding sink roll journals

The hot dip galvanizing process may involve several baths whose aggressiveness depends on chemical composition, bath temperature and other production related factors. Commonly applied bath compositions are pure molten Zn at a working temperature of 420-500 °C or AlZn molten alloys at a working temperature of 660 °C. The service life of sink roll journals and kettle walls depends on the above mentioned production factors, but also on the material of the journal. In the case of commonly used 316L material, repair may already be needed after 2-3 days of service.

Overlay welding with SK ZIP-O self-shielded cored wire substantially improves the service life of the journals.



In a comparative test with 316L material, after 7 days of immersion in molten Al-Zn, a substantially lower diameter reduction is observed as well as a more regular wear pattern, causing less ovality of the roll supporting arms.

128/2017/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global top company for the daily challenges in the areas of joint welding, repair, hardfacing and cladding as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. With individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges.voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

Lasting Connections – As a pioneer in innovative welding consumables, Böhler Welding offers a unique product portfolio for joint welding worldwide. More than 2000 products are adapted continuously to the current industry specifications and customer requirements, certified by well-respected institutes and thus approved for the most emanding welding applications. As a reliable partner for customers, „lasting connections" are the brand's philosophy in terms of both welding and people.

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