

#### Tailor-Made Protectivity™

# REPAIR AND MAINTENANCE WELD OVERLAY SOLUTIONS FOR STEEL MILLS



voestalpine Böhler Welding www.voestalpine.com/welding



# 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, antiwear 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.

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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

Raw Material Handling	Preparation Plant	I Steel & Iron Making and Casting I	
Mining	Sintering plant		
Crushing and grinding Scrap shredding	Coking plant Direct reduction plant	Blast furnace LD EAF RH degassing unit	Continu ous caster

Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure	
Wear plates	Abrasion		Cored wires			
	High temperatures		SK 162-0 SK 867 WP-0	63 HRC 62 HRC	Austenitic matrix with Cr carbides Austenitic matrix with Cr carbides	
1/1	Impact		SK A43-O	64 HRC	Austenitic matrix with Cr and Nb carbides	
ser /	Corrosion		SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides	
	Metal to metal					
Scrap shredders	Abrasion		Cored wires			
	High temperatures		SK A43-0	205HB/50HRC** 64 HRC	Austenite Austenitic matrix with Cr and Nb carbides	
	Impact		Stick electrodes			
	Corrosion		UTP BMC UTP LEDURIT 65	260HB/50HRC** 65 HRC	Austenite Austenitic matrix with Cr, Nb, Mo, W and V	
	Metal to metal				complex carbides	





## PREPARATION PLANT



#### Iron ore and coal handling

Component	Predominant wear modes	Ir	Intensity		Intensity		tensity Recommended consumables*		Recommended consumables*	Hardness	Microstructure
Raw material mixing	Abrasion				Cored wires	Matrice					
Sec. Sec.	High temperature				SK 900 INI RTC-O/G	50 / 44 HRC	carbides				
	Impact					3000 HV					
	Corrosion				SK ABRA-MAX O/G	70 HRC	Homogeneously dispersed complex carbo-borides and borides				
	Metal to metal										
Sinter breaker	Abrasion				Cored wires	47.LIDC	Austopitic matrix with Cr. Nh. Ma. W. and V.				
the	High temperature				SK A45-O		complex carbides				
Sandi Camp	Impact				SK A83-OSP	62 HRC	Austenitic cast iron with complex carbides				
SUSSIN TO	Corrosion				Stick electrodes UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V				
EL REICH	Metal to metal						complex carbides				
Sinter bars	Abrasion				Cored wires	(7.110.0					
	High temperature				SK A45-O SK A83-OSP	63 HRC 62 HRC	Austenitic matrix with Cr, ND, Mo, W and V complex carbides				
	Impact				Stick electrodes		Austenitic cast iron with complex carbides				
	Corrosion				UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides				
	Metal to metal										



Component	Predominant wear modes	In	ten	sity	Recommended consumables*	Hardness	Microstructure
Exhaust fans	Abrasion				Cored wires	200 HR	Austonito
A TEFT	High temperature				SK 4 43-0 SK A 45-0	64 HRC	Austenitic Cast iron with Cr and Nb carbides
	Impact					70 LIDC	complex carbides
	Corrosion				SK ABRA-MAX U/G	65 HRC	carbo-borides and borides
	Metal to metal				SK A 43-OB		Austenitic cast iron with Cr and Nb carbides
			5 U U U		Stick electrodes UTP 63 UTP Abrasodur 43+ UTP LEDURIT 65	180 HB 63 HRC 65 HRC	Austenite Austenitic cast iron with Cr and Nb carbides Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
Sinter grinding	Abrasion					Matrix	Austopitic NiCoDC motois with two actors
	High temperature				SK 900 NI RIC-0/G	50 / 44 HRC	carbides
	Impact					3000 HV	
	Corrosion						
19 ~	Metal to metal						
Sinter wagon	Abrasion				Cored wires	4 4 9 1 1 5	
	High temperature				SK FINIM4-G	140 HB	Austenitic Feini alloy
	Impact				Solid wire UTP A 8051 Ti	200 HB	Ferritic & austenitic nodular cast iron
	Corrosion				Stick electrodes	220 HB	Austenitic FeNi alloy
N /2 8	Metal to metal				UTP 86 FN		
Direct reduction of iron	Abrasion				Cored wires	100110	
	High temperature				SK A 45-0	63 HRC	Austenitic NICr alloy Austenitic matrix with Cr, Nb, Mo, W and V
CREATE THE THE	Impact				Stick electrodes		complex carbides
	Corrosion				UTP 068 HH UTP LEDURIT 65	180 HB 65 HRC	Austenitic NiCr alloy Austenitic matrix with Cr, Nb, Mo, W and V
	Metal to metal						complex carbides

### ABRASION RESISTANCE REQUIRES PRESENCE OF CARBIDES



#### 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% O2 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	170 HB	Austanita + Farrita
	High temperature				SK 258L-O/SA	44 HRC	Martensite
	Impact				31 443-073	04 HICC	carbides
	Corrosion						
	Metal to metal						
Rotating chutes	Abrasion				Cored wires	63 HRC	Austenitic matrix with Cr. Nb. Mo.
	High temperature				SK 483-OSP		W and V complex carbides
	Impact					02 TIKC	Austenite + co + complex carbiaes
	Corrosion						
	Metal to metal						
Hot air blowing nozzles	Abrasion				Cored wires	50 HRC	l amellar arev cast iron
	High temperature				SK GS-O	220 HB 60 HB	Spheroidal graphite cast iron
A THE THE	Impact				UTP A 38		Pure copper
	Corrosion				UTP 39	60 HB	Pure copper
E A A A A	Metal to metal				012 20	220HB	Spherolaal graphite cast from
Ladle transportation	Abrasion				Cored wires	330 HB	Bainite
DAL-SA	High temperature				SK 450-G	47 HRC	Martensite
	Impact				SK 242-S	40 HRC	Martensite
	Corrosion				UTP AF ROBOTIC 405	37-42 HRC	Martensite
	Metal to metal				UTP DUR 350	370 HB	Bainite



Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Slag pots	Abrasion		Cored wires		
	High temperature		SK Soudocore S8-O	190 HB	Ferrite
7 = 11-2	Impact				
	Corrosion				
	Metal to metal				
Electric arc furnace	Abrasion			220 110	
A LA	High temperature		UTP AF 068 HH	180 HB	Austenitic NiCr alloy
	Impact		Stick electrodes	000115	
	Corrosion		UTP 068 HH	220 HB 180 HB	Austenitic NiCrMo alloy Austenitic NiCr alloy
	Metal to metal				
Basic oxygen convertor	Abrasion		Cored wires		Painita
	High temperature		SK 450-G	47 HRC	Martensite
	Impact		SK 242-O/S	40 HRC	Martensite
	Corrosion		SK 252-075 SK AP-O/S	205HB/50HRC	Austenite
	Metal to metal		UTP AF ROBOTIC 405	48 HRC	Martensite
BOF scrap charging chute	Abrasion		Cored wires		Mentensitie - Timeshidee
	High temperature		SK 258 HC-O SK 650-G	58 HRC 60 HRC 60 HRC	Martensitic + 11 carbides Martensite Austenitic matrix + Cr carbides
	Impact		SK 255-0		
A BARREN IN	Corrosion				
	Metal to metal				
Fume exhaust pipes	Abrasion		Cored wires	63 HRC	Austenitic matrix + Crearbidee
	High temperature		SK OXY-M	-	Cermets
	Impact				
	Corrosion				
	Metal to metal				
Converter chimney	Abrasion		Cored wires	_	Ni-Si-B multiphasic microstructure
Contractor	High temperature		SK 840-MF	-	Ni-Cr-Si-B multiphasic
	Impact		SKOATT		Cermets
	Corrosion				
010	Particle erosion				

# CONTINUOUS CASTING



Component	CC zone	Recommended consumables*	Hardness	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		
Identification of wear modes along a CC line	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
① ② 75% chemical wear + 25% mechanical wear   ③ 75% mechanical wear + 25% chemical wear   ④ 100% mechanical wear	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
3 (4) Recommended alloys for overlay	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
① 13Cr+4Ni+Mo-LC ② 13Cr+Ni+Mo+C ③ 12Cr+Mo+C ④ 5Cr+Mo, W, V	* For more de welding or co	tailed information, see our Produc ntact your local UTP Maintenance	t Data Sheets office.	at http://www.voestalpine.com/

### 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 recirculated 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	Chemico	Chemical composition, wt%									
		с	Mn	Si	Cr	Ni	Мо	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.

	с	Mn	Si	Cr	Ni	Мо	Nb	۷	Ν	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.



# 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

	с	Mn	Si	Cr	Ni	Мо	Nb	Fe	И
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		Austanita with solid strengthening precipitates
	High temperature		SK Tool Alloy Co-G	230 HB	Austenite with solid strengthening precipitates
	Impact		SK U520 Co-G	190 HB	Austenite with aspersed of and the precipitates Austenite with solid strengthening precipitates
	Corrosion		Stick electrodes	77.1.000	
	Metal to metal		UTP Ceisit 721	37 HRC	Austenite with dispersed Cr and Mo precipitates
Slab scale scraper	Abrasion		Cored wires SK D12-G	56 HRC	Martensite
	High temperature		SK D35-G	50 HRC	Martensite
the state	Impact				
	Corrosion				
P.N.S.	Metal to metal				
Scale breaker	Abrasion		Cored wires SK 385-SA	54 HRC	Chromium carbides in a martensitic matrix with
	High temperature		SK 740-SA	46 HRC	residual austenite Martensite + 10% Ferrite
	Impact		SK 461C-SA	54 HRC	Martensite + max 20% Ferrite
AND TRAINING OF	Corrosion				
N.	Metal to metal				
Conveying rolls	Abrasion		Cored wires SK 650-G	58 HRC	Martensite
B I Land	High temperature		UTP AF ROBOTIC 606	60 HRC 55 HRC	Martensite Martensite
The summer of	Impact		SK 258-SA SK 385-SA	57 HRC	Martensite Chromium carbides in a martensitic matrix with
1 1-1-1-1	Corrosion		Strip & flux	54 mile	residual austenite
and the second second	Metal to metal		RECORD EST 423	54 HRC	Martensite
Hot rolling mills	Abrasion		Cored wires SK 740-SA	46 HRC	Martensite + 10% Ferrite
	High temperature		SK 263-SA SK 258L-SA	50 HRC 44 HRC	Martensite Martensite
	Impact		SK 258 NbC-SA	58 HRC	Martensite + Nb carbides Martensite + max 20% Ferrite
	Corrosion			0 millio	
	Metal to metal				

Component	Predominant wear modes	Intensity	Recommended consumables*	Hard- ness	Microstructure						
Hot rolling mills											
Back-up rolls	Abrasion		Cored wire	57 HRC	Martensite + Nb and W carbides						
	High temperature		SK 250INDC-SA								
	Impact										
	Corrosion										
	Metal to metal										
Bearing chock	Abrasion		Strip-flux								
	High temperature		SOUDOTAPE 430 /	230 HB	Martensite + Ferrite						
	Impact		RECORD RT 159								
	Corrosion										
	Metal to metal										
Working rolls	Abrasion		Strip-flux								
	High temperature		SOUDOTAPE 430 /	52 HRC	Martensite						
	Impact		RECORD EST 423								
	Corrosion										
	Metal to metal										
Edger rolls	Abrasion		Cored wires	50 HPC	Martonsite						
	High temperature		SK 203-3A SK 461C-SK	54 HRC							
	Impact										
	Corrosion										
	Metal to metal										
Coiling											
Pinch rolls	Abrasion		Cored wires		Martensite + 10 % Ferrite						
	High temperature		Strip flux	++ mile							
	Impact		combination	40 HRC							
	Corrosion		RECORD RT 742								
	Metal to metal										
Pinch rolls	Abrasion		Cored wire	57 HPC	Martensite + carbides						
	High temperature		Strip-flux combination SOUDOTAPE 258 / RECORD EST 122	55 HRC	Fightensite + Carbides						
	Impact										
	Corrosion										
	Metal to metal										
Coiler	Abrasion		Cored wires	54 HRC 54 HRC	Martensite + max. 20% Ferrite						
	High temperature		SK 385-SA								
	Impact										
Summer Langunger	Corrosion										
10	Metal to metal										

## 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 UTP AF ROBOTIC		315 HB 45 HRC 330 HB 350 HB	Martensite Martensite Bainite Bainite
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					
Tension levelers	Abrasion		<b>Cored wires</b> 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		170 HB	Fully austenitic
T	High temperature					
	Impact					
	Corrosion					
	Metal to metal					

#### 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.



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We are a leader in the welding industry with over 100 years of experience, more than 50 subsidiaries and more than 4,000 distribution partners around the world. Our extensive product portfolio and welding expertise combined with our global presence guarantees we are close when you need us. Having a profound understanding of your needs enables us to solve your demanding challenges with Full Welding Solutions - perfectly synchronized and as unique as your company.



**Lasting Connections** – Perfect alignment of welding machines, consumables and technologies combined with our renowned application and process know-how provide the best solution for your requirements: A true and proven connection between people, products and technologies. The result is what we promise: Full Welding Solutions for Lasting Connections.

Tailor-Made Protectivity<sup>™</sup> – The combination of our high-quality products and application expertise enables you to not only repair and protect metal surfaces and components. Our team of engineers, experienced in your specific applications, offer you customized solutions resulting in increased productivity for your demanding challenge. The result is what we promise: Tailor-Made Protectivity<sup>™</sup>.

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