



SIDUR...
WEAR RESISTANT STEEL

SIMAXX...
HIGH STRENGTH STEEL

sij...

Wear-resistant and high-strength steels
SIDUR | SIMAXX





SIJ is a vertically integrated holding company, the leading steel manufacturer in Slovenia, and one of the largest stainless and special steel manufacturers in Europe. SIJ Group consists of the two largest steel companies in Slovenia (SIJ Acroni and SIJ Metal Ravne), other manufacturing and processing companies (SIJ Ravne Systems, SIJ Elektrode, SIJ SUZ), specialized service and sales centers across Europe and the USA, and companies for scrap steel collection and sales.

www.sij.si



INCREASE YOUR PRODUCT'S LIFESPAN.

The highest steel quality, based on world class production equipment and more than 400 years of experience in steel making.



DECREASE MACHINING COSTS.

Narrow dimensional tolerances, exceeding international standards.



OPTIMIZE YOUR MANUFACTURING PROCESSES.

Extensive range of mechanical treatment possibilities to find the best fit for your production process.



EXCEED YOUR CUSTOMERS' EXPECTATIONS.

Strong in-house R&D Department and broad applied knowledge helps you get the best solutions for your customers' needs.



SIDUR...



SIDUR...



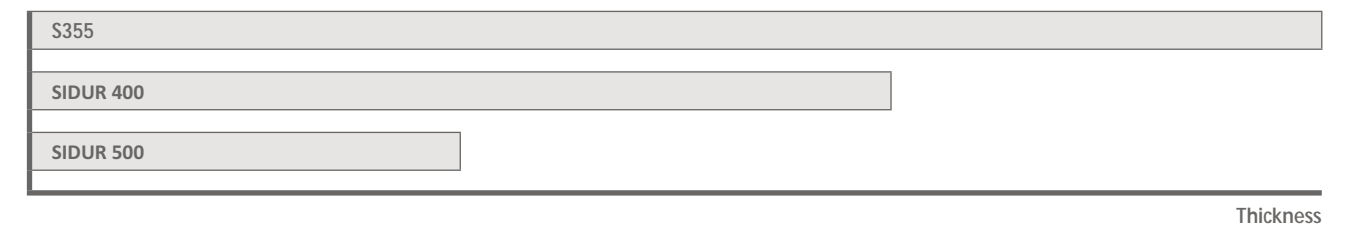
SIDUR represents a family of wear-resistant steels with optimized hardness, strength, and toughness. This makes it durable and suitable for use in the most difficult environments where there is a risk of abrasion caused by contact with hard minerals and other abrasive materials.

SIDUR – EXTREME RESISTANCE TO ABRASIVE WEAR

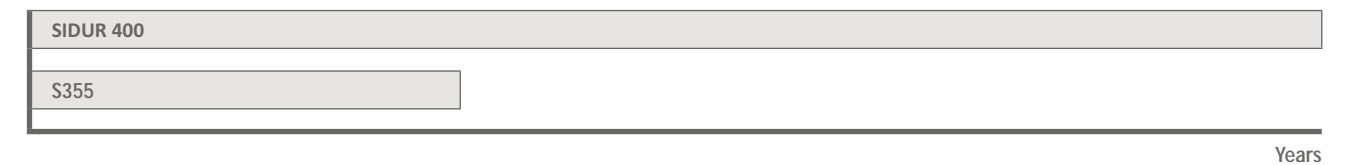
SIDUR steels are produced within a hardness range from 220 to 540 HBW. Compared to non-alloyed structural steels, SIDUR plates have higher durability which extends the lifespan of your products up to three times.

The unique combination of mechanical properties improves bending, welding, and machining properties and deformation levels. SIDUR is a material well suited to a wide variety of applications, where resistance to heavy wear by hard minerals and other abrasive materials is required.

BETTER PERFORMANCE AT LOWER THICKNESS



UP TO THREE TIMES LONGER LIFESPAN OF PRODUCTS



For the best performance with proper material selection, wear factors, such as type of counter-body, humidity etc., should be considered. All these factors significantly increase the lifespan of a finished product.

SPECIAL SIDUR GRADES

SIDUR 350 HI TEMP AND SIDUR 350 MACHINABILITY +

– resistance against softening

SIDUR fine-grained steel combines sufficient resistance to mechanical wear and heat resistance up to 450°C with good weldability and machining, mainly due to the uniform cross-section microstructure. The material responses in temperatures up to 500 °C are provided in the table below for SIDUR 350 HI TEMP. The typical limitations of water-quenched steels in temperatures up to 220 °C are not observed in this case.

SIDUR 3401

– increasing hardness with exposure to wear

The virtue of high manganese steel SIDUR 3401 (Hadfield steel, X120Mn12) is high wear resistance and a work-hardening effect on the steel structure. With exposure to dynamic loads, hardness can be increased by three times compared to its delivered condition.



SIDUR APPLICATIONS

Bulldozers, earth-moving crusher jaws, shredder plates, shovel buckets, dump trucks, industrial trucks, lorries, **containers for iron ore**, machine parts and tools for mineral extraction (mining), metal working tools – cutting edges, knives, gears, bearings, loaders, buckets, slurry pipe systems, **guiding and shifting plates**, liners for shot blasting units, shot blasting equipment.

CHEMICAL COMPOSITION IN %

Ladle analysis	C max	Si max	Mn max	S max	P max	Cr max	Ni max	Mo max	B max
SIDUR 250	0.18	0.6	1.6	0.001	0.012	1.2	0.5		
SIDUR 300	0.22	0.6	1.6	0.003	0.012	1.3	0.5		
SIDUR 400	0.26	1.0	1.5	0.002	0.012	1.0	1.0	0.5	0.004
SIDUR 450	0.27	1.0	1.5	0.002	0.012	1.0	1.0	0.5	0.004
SIDUR 500	0.29	1.0	1.5	0.002	0.012	1.0	1.0	0.5	0.004
SIDUR 350 HI TEMP	0.12	0.5	1.8	0.001	0.015	2.1	1.3	0.25	
SIDUR 3401	1.3	0.4	13	0.001	0.02	0.55			

MAXIMUM CARBON EQUIVALENT $CEV = C+MN/6+(NI+CU)/15+(CR+MO+V)/5$

Grade Thickness range	8–25mm	25–40mm	Above 40 mm
SIDUR 400	max. 0.46	max. 0.59	max. 0.67
SIDUR 450	max. 0.49	max. 0.59	max. 0.74
SIDUR 500	max. 0.59	max. 0.66	max. 0.75

HARDNESS HBW AND DELIVERY CONDITION

Hardness (HBW)	8–25 mm	25–40 mm	Above 40 mm			
SIDUR 250	SIDUR 300	SIDUR 400	SIDUR 450	SIDUR 500	SIDUR 350 HI TEMP	SIDUR 3401
220–280	260–340	360–440	420–470	460–540	Min. 300 HB	Max. 240 HB
Rolled	Rolled	Quenched and tempered	Quenched and tempered	Quenched and tempered	Normalized	Solution annealed

According to EN ISO 6506-1. Measured 0.5–2 mm below the surface.

TYPICAL MECHANICAL CHARACTERISTICS AT ELEVATED TEMPERATURES FOR SIDUR 350 HI TEMP

Temperature [°C]	Rp0.2 [Mpa]	Rm [Mpa]	A50 [%]
500	757	888	13
400	903	1080	17.5
300	934	1140	17
200	918	1060	11
100	907	1050	11.5
Room	911	1125	14

MECHANICAL PROPERTIES*

	Yield strength (minimal) Re or Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation (minimal) A5 [%]	Charpy V-Notch
SIDUR 250	750	940	15	–20 °C 30 J
SIDUR 300	820	1030	15	–20 °C 30 J
SIDUR 400	900	1300	12	–20 °C 30 J
SIDUR 450	1100	1450	10	–20 °C 30 J
SIDUR 500	1300	1650	8	–20 °C 25 J
SIDUR 350 HI TEMP	660	1000	10	–20 °C 27 J
SIDUR 3401	350	800–1000	30	

Typical values for 15 mm plate thickness

* orientational value

DIMENSIONAL RANGE*

	Thickness [mm]*	Width [mm]*	Length [mm]
SIDUR 250	8–60	1000–2500	2000–12000
SIDUR 300	8–60	1000–2500	2000–12000
SIDUR 400	8–110	1000–2500	2000–12000
SIDUR 450	8–100	1000–2500	2000–12000
SIDUR 500	8–100	1000–2500	2000–12000
SIDUR 350 HI TEMP	6–60	1000–2500	2000–12000
SIDUR 3401	2–80	1000–2500	2000–12000

*Must be agreed before ordering

TOLERANCES

Upon request, narrower tolerances for thickness, shape, length, width and flatness are available than those required by EN 10029.

SURFACE PROPERTIES

According to EN 10163-1.

Anticorrosive primer red oxide colour available upon request.

SIDUR IN A WORKSHOP

BENDING RECOMMENDATIONS

R/t		W/t				
	Thickness	Transverse	Longitudinal	Transverse	Longitudinal	Springback
SIDUR 400	8 ≥ t < 20	3.0	4.0	10.0	10.0	9–13
	t ≥ 20	4.5	5.0	12.0	12.0	
SIDUR 450	8 ≥ t < 20	4.0	5.0	10.0	12.0	11–18
	t ≥ 20	5.0	6.0	12.0	14.0	
SIDUR 500	8 ≥ t < 20	5.0	6.0	12.0	14.0	12–20
	t ≥ 20	7.0	8.0	16.0	18.0	

Minimum recommended punch radius (R) and die opening width (W) for plate thickness (t) when the plate is being bent to 90° along the direction of rolling and at right angles to the direction of rolling – and also the corresponding springback.

Note: Thermal cut and sheared edges must be properly prepared before bending.

CUTTING RECOMMENDATIONS

SIDUR can be cut by using regular thermal cutting processes or by using cold methods of shearing for thin plates. Water-jet is also possible. There is no risk of softening and distortion. When cutting thicker SIDUR plates, especially when using oxy-fuel, special care must be taken before and after the cutting process to prevent (delayed) cut edge cracking. Plate preheating is one of the most important solutions before cutting. Additional controlled cooling or post–heating of the cut edge is also carried out where necessary to reduce residual stresses. Preheating is more reliable for reduction or redistribution of buildup stresses than postheating due to the hardening effect in the HAZ. Nevertheless, it is useful for hydrogen removal in the case of oxy-fuel. Cooling, where possible, is done by pilling even if the steel was not preheated.

Method of cutting:	submerged plasma	dry-plasma / oxy-fuel	laser	water jet
Method of preheating:	-	blow-pipe system / furnace / torch / warm pilling / electric heating mats	-	-
Heating temperature:	See Table of recommended min. preheating temperature. The max. preheating temperature is 220 °C.		-	-
Soaking time in minutes per mm:	-	Min. 3 min/mm at min. temperature	-	-
Cooling method:	insulating blanket / warm pilling / furnace		-	-
If the blow-pipe system is used, temperature measurement should be done on the opposite side of the plate.				

WELDING SIDUR

Welding process or procedure*	Welding materials / Welding process	EN Designation (EN ISO 2650, EN ISO 3581, EN ISO 3580, EN ISO 636, EN ISO 14171, EN ISO 14174, EN ISO 16834, EN ISO 21952, EN ISO 17632, EN ISO 14343, EN ISO 14341)	SIJ Elektrode Designation	SIJ Acroni Wear Resistant Plate Grade						
				SIDUR 250	SIDUR 300	SIDUR 400	SIDUR 450	SIDUR 500	SIDUR 350 HI TEMP	SIDUR 3401
Welding	SAW Fluxes / Wires	SA FB 1 55 AC H5/S 3	FBTT/EPP3	•	•	•	•	•	•	
		SA FB 1 55 AC H5	FBTT/Filtub 132			•	•	•	•	
			FBTT/Filtub 138			•	•	•	•	
			Welding *	Electrodes MMAW	E 42 4 B 32 H5	EVB 50	•	•	•	•
E 42 6 B 42 H5	EVB 55	•			•	•	•	•		
Flux-cored wires FCAW	T 46 4 M M 1 H5	Filtub 12M		•	•	•	•			
	T 42 4B C3 H5 / T 42 4B M3 H5	Filtub 12B		•	•	•	•	•		
Wires GMAW, GTAW	G 42 4 C/M G 3 Si1	VAC 60		•	•	•	•			
	G 46 4 C/M G 4 Si1	VAC 65		•	•	•	•			
Welding **	Electrodes MMAW	E 692MN2NiCrMoB42	EVB 75		•	•	•	•	•	
	Electrodes MMAW	E 692MN2NiCrMoB42	EVB 80		•	•	•	•	•	
		E 89AMn2NiCrMoB42	EVB 100			•	•	•	•	
	Flux-cored wires FCAW	T 69 4 Mn 2Ni Cr Mo M 1 H5	Filtub 32M			•	•	•	•	
		T 69 6 Mn2NiCrMo B M (C)3 H5	Filtub 32B			•	•	•	•	
	Wires GMAW, GTAW	Mn3Ni1CrMo	MIG 75		•	•	•	•	•	
	Hardfacing	Electrodes MMAW	Fe 1	E DUR 250	•					
			E DUR 300		•					
Fe 2			E DUR 500					•		
Fe 3			E DUR 400			•	•			
Fe 8			E DUR 600						•	
Flux-cored wires FCAW		Fe 1	Filtub DUR 3	•	•					
			Filtub DUR 5		•	•	•			
		Fe 7	Filtub DUR 12			•	•			
		~Fe 3	Filtub DUR 15/ DUR 16					•	•	
		E 307 T0-1	FilCORD 307							•
Interlayer	Electrodes MMAW	E 18 8 Mn B 22	Inox B 18/8/6	•	•	•	•	•		•
	Wires GMAW, GTAW	G 18 8 Mn	MIG/ TIG 18/8/6Si	•	•	•	•	•	•	•
	SAW Fluxes / Wires	SA AF 2 54 DC/ S 18 8 Mn	FB33/ EPP 18/8/6	•	•	•	•	•	•	

RECOMMENDED WELDING PROCEDURES

1. For SIDUR steels in combination with unalloyed material types S355, we recommend welding materials marked with *.
2. For welding SIDUR steels with each other, for root and filling passes, we recommend under matching welding materials marked with * or fine-grained welding materials marked with **. To achieve higher hardness on the surface, cover layers should be welded with suitable hardfacing welding materials.
3. For cladding on SIDUR steels, we recommend buffer layer with austenitic 307 (18/8/6) welding materials without preheating and cover layers with suitable welding materials.

MINIMUM RECOMMENDED PREHEAT TEMPERATURE

Minimum recommended preheat temperature [°C]																		
	8	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80		
SIDUR 400	Room temp.				75				100	175								
SIDUR 450	Room temp.				125				150									
SIDUR 500	Room temp.			175			200											

For thicknesses up to 13 mm | Data from the table is applicable to single plate thickness when welding with a heat input of 1.7 kJ/mm. | The consumables determine the preheating temperature if its carbon equivalent is higher than that of the plate | Room temperature is approx. 20 °C.

MAXIMUM RECOMMENDED INTERPASS TEMPERATURE

Maximum recommended interpass temperature [°C]	
SIDUR 400	225
SIDUR 450	225
SIDUR 500	225

SIJ Acroni SIDUR steels have good weldability. When welding thin plates, preheating is normally not necessary (if the ambient temperature is > 5 °C).

PREHEATING IS RECOMMENDED:

- at outside temperatures below 5 °C;
- at thicknesses above 20 mm;
- at risk of moisture and condensation.

In these cases, the recommended preheat temperature during fusion welding processes should not exceed 200 °C as this can cause reduction in hardness.

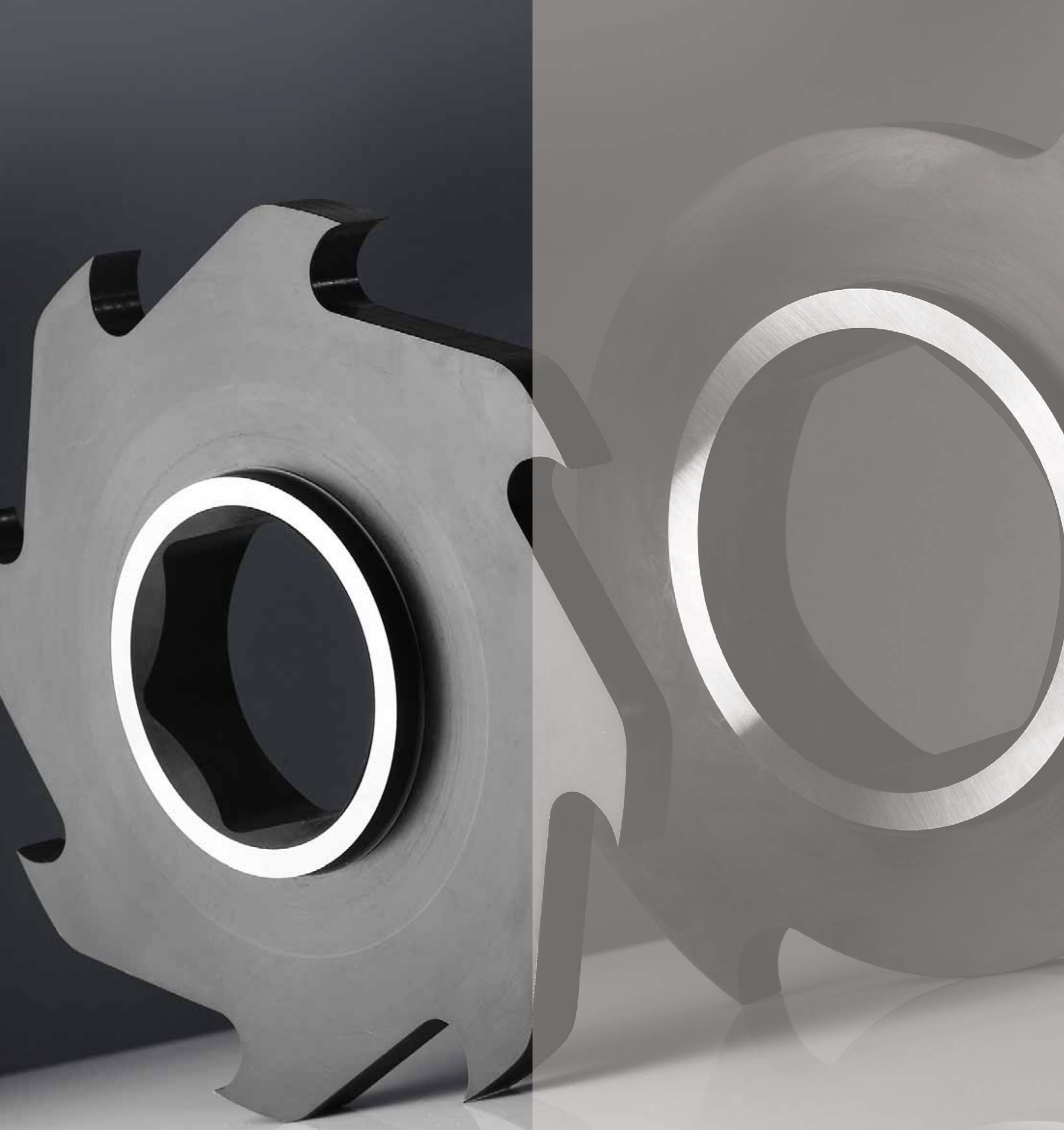
Welding should be carried out immediately after the joint faces are finished to avoid surface contamination. All potential contact surfaces with welding metal should always be ground to white. Consumables must be properly stored, always according to the manufacturer`s recommendations. Basic coated electrodes should be dried before welding.

In repair welding and joint welding, sharp edges should be avoided and the first layer of weld material should be of thinner dimensions to make sure the energy intake is as low as possible.

Recommended welding consumables are produced by SIJ Elektrode.

All welding instructions are recommendations only.

Welding recommendations are also available in EN 1011-2. General guidelines for arc welding are available in EN 1011-1.



SIDUR CASE STUDY



PERFORMANCE and DURABILITY in PERFECT BALANCE

INDUSTRIAL KNIVES MADE OF
SIDUR WEAR-RESISTANT STEEL

“Where extreme wear on knives and other components is expected, the choice of appropriate material is crucial. From the perspective of mechanical treatment, SIDUR can be easily worked with. SIDUR’s excellent plate flatness and narrow tolerances allow us to omit surface treatment for some types of industrial knives and wear parts, thereby saving time and money.

According to our measurements, the lifetime of parts produced using SIDUR and SIDUR HI TEMP is up to three times longer in comparison to other steels. To avoid abrasive wear on industrial knives and wear parts, we recommend welding on parts which are most often exposed. Using SIDUR enables us to boost the performance of our clients.”

Stanko Ravlan, Production Manager, SIJ Ravne Systems



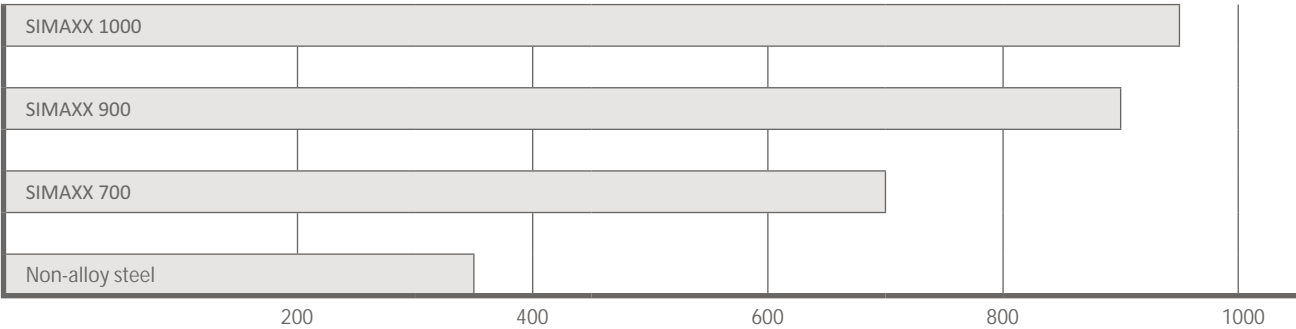
SIMAXX^{...}



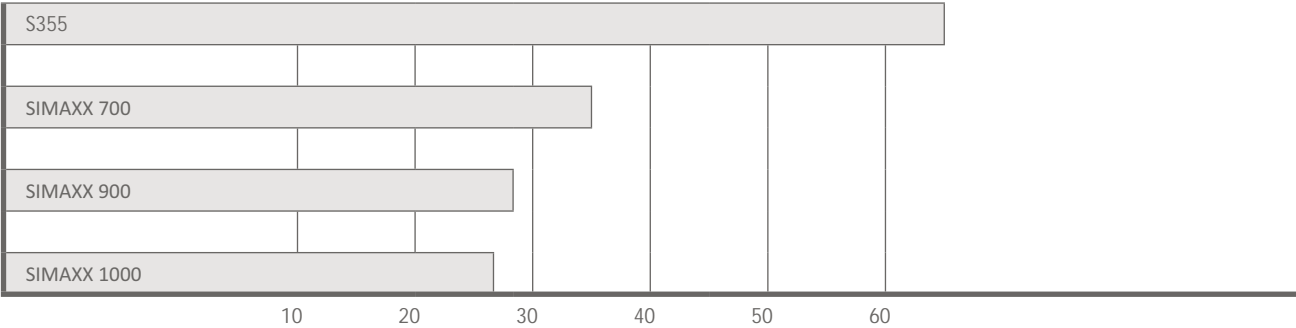
SIMAXX is a high-strength steel that makes structures lighter; it is tough and has a homogeneous structure – properties that deliver optimal results. Its extensive shaping possibilities make SIMAXX steel ideal for use in a wide range of industries.

In comparison to non-alloyed structural steel grades, the use of SIMAXX gives better results at lower thickness. Lifting equipment and transport vehicles become lighter and can carry more. The thinner plates require less demanding welding, resulting in lower costs of production.

Yield strenght comparison



Same strenght at lower thickness





SIMAXX APPLICATIONS

Fork lifts, excavator buckets, loader buckets, rippers, wind power and offshore cranes, wind power and offshore towers, ship cranes, forestry machines, bridges, light building structures, mining buckets, mining shovels, mining trucks, polygrabs, refuse vehicles, special trailers (heavy loads), mobile cranes, telescopic booms, pipes, mobile bridges.

CHEMICAL COMPOSITION IN %

Ladle analysis	C max	Si max	Mn max	S max	P max	Cr max	Ni max	Mo max	B max
SIMAXX 700	0.18	0.5	1.5	0.002	0.012	1	1.20	0.5	0.005
SIMAXX 900	0.18	0.5	1.5	0.002	0.012	1	1.20	0.5	0.005
SIMAXX 1000	0.19	0.5	1.6	0.002	0.012	1.2	1.20	0.6	0.005

MECHANICAL PROPERTIES

	Yield strength (minimal) Re [MPa]	Tensile strength Rm [MPa]	Elongation (minimal) A ₅ [%]
SIMAXX 700	690	770–940	14
SIMAXX 900	890	940–1100	11
SIMAXX 1000	960	980–1150	10

Values valid for plates up to 50 mm in thickness. According to EN 10025-6 + A1

IMPACT PROPERTIES

	Test temperature [°C]	Impact energy Charpy V-notch, transverse (min.) [J]
Q	–20	27
QL	–40	27
QL1	–60*	27

According to EN 10025-6 + A1

* Except for SIMAXX 1000

DELIVERY CONDITIONS

Quenched and tempered (Q + T)

Quenched and tempered + shotblasted + primed

DIMENSIONAL RANGE*

	Thickness [mm]	Width [mm]	Length [mm]
SIMAXX 700	8–100	1000–2500	2000–12000
SIMAXX 900	8–60	1000–2500	2000–12000
SIMAXX 1000	8–60	1000–2500	2000–12000

*Must be agreed before ordering

TOLERANCES

Upon request, narrower tolerances for thickness, shape, length, width and flatness are available than those required by EN 10029.

SURFACE PROPERTIES

According to EN 10163-1.

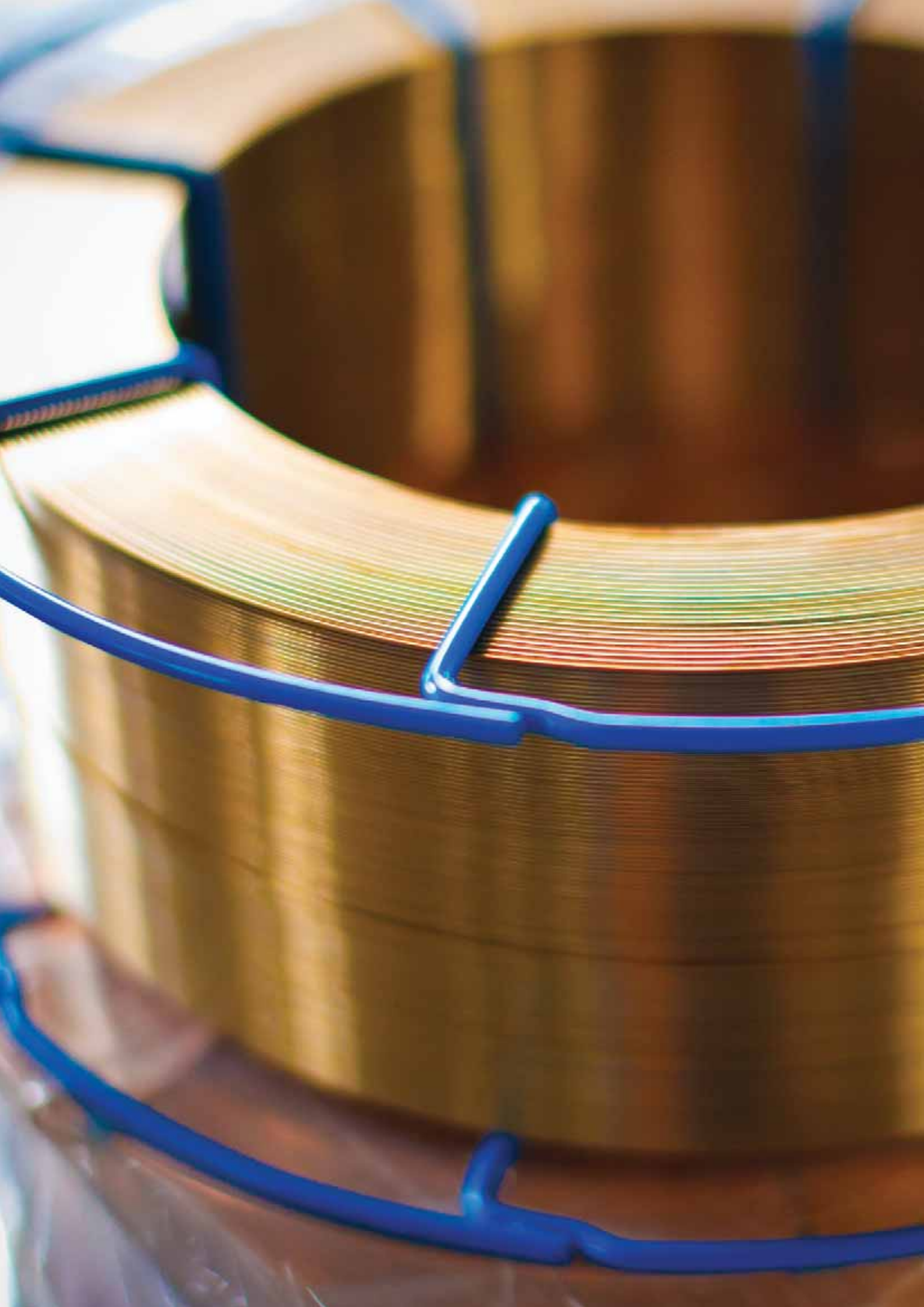
Anticorrosive primer red oxide color upon request.

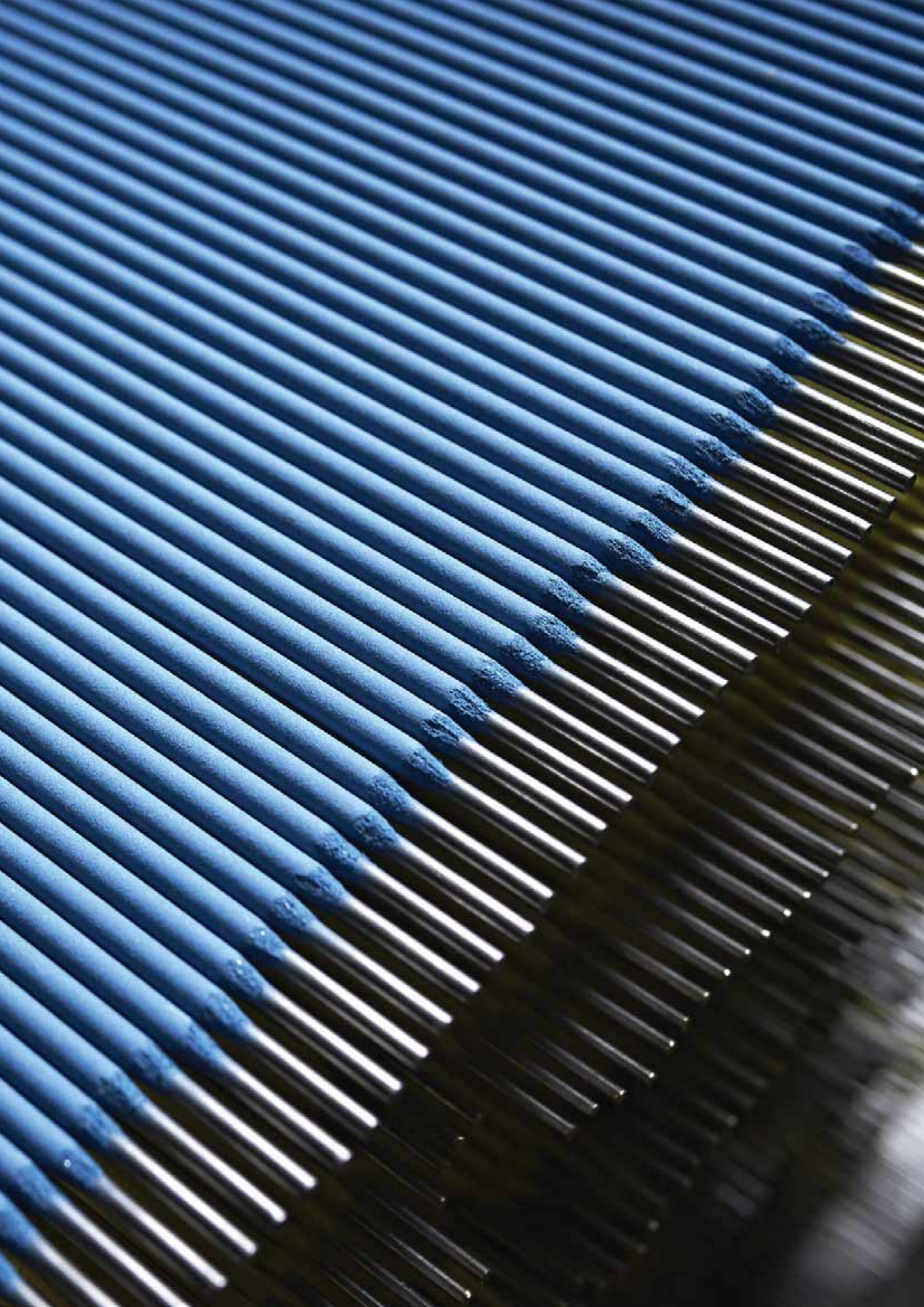
SIMAXX IN A WORKSHOP

BENDING

	R/t			W/t		
	Thickness	Transverse	Longitudinal	Transverse	Longitudinal	Springback
SIMAXX 700	$8 \geq t < 20$	2.0	3.0	7.0	8.5	6–10
SIMAXX 900/1000	$8 \geq t < 20$	3.0	4.0	8.5	10.0	8–12

Minimum recommended punch radius (R) and die opening width (W) for plate thickness (t) when the plate is bent to 90° along the di-
rection of rolling and at right angles to the direction of rolling – and also the corresponding springback.





WELDING SIMAXX

Welding materials / Welding process	EN Designation (EN ISO 2650, EN ISO 14171, EN ISO 14174, EN ISO 16834, EN ISO 17632, EN ISO 14341, EN ISO 18276)	SIJ Elektrode Designation	SIJ Acroni grade		
			SIMAXX 690	SIMAXX 890	SIMAXX 960
Electrodes MMAW	E 692Mn2NiCrMoB42	EVB 75	•		
		EVB 80	•		
	E 89AMn2Ni1CrMoB42	EVB 100		•	•
	E 89 4 ZB62 H5	EVB 100Extra			•
Flux-cored wires FCAW	T 89 4 Mn2Ni1CrMo BM3 H5	Filtub 38B		•	•
Flux-cored wires FCAW	T 69 6 Mn2NiCrMo B M (C)3 H5	Filtub 32B	•		
	T69 6 Mn2NiMo B M	Filtub 32M	•		
	T89 4 ZMM2 H5	Filtub 38M		•	•
Wires GMAW, GTAW	Mn3Ni1CrMo	MIG 75	•		
	89 6M GMn4Ni2CrMo	MIG 90		•	•
	Mn4Ni2,5CrMo	MIG 95			•
SAW Fluxes / Wires	SA FB 1 55 AC H5	FBTT/Filtub 132	•		
		FBTT/Filtub 138		•	•

Despite the improved weldability of high-strength SIMAXX steels, correct welding procedures should always be followed. Root-welding passes should be welded with softer filler materials (undermatching), while similar fine-grained welding materials are recommended for filling and cover passes – see the table above.

Welding SIMMAX steels with non-alloy materials can be done using materials intended for non-alloy steels.

For welding SIJ Acroni SIMAXX steels, welding with low energy input is recommended, which involves an optimum welding current and welding with more passes. Welding with an exceedingly high energy input can result in excessive grain growth in the HAZ (heat-affect-ed zone), which greatly deteriorates mechanical properties.

Our experts recommend welding immediately after the joint faces are finished, to avoid contamination. Coated electrodes must be dried before welding.

MINIMUM RECOMMENDED PREHEAT TEMPERATURE

Minimum recommended preheat temperature [°C]																			
	8	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	
SIMAXX 700	Room temperature					75					100								
SIMAXX 900	75					100						Not available in this thickness range							
SIMAXX 1000	75*	100																	

For thicknesses up to 13 mm | Data from the table is applicable to single plate thickness when welding with a heat input of 1.7 kJ/mm

| The consumables determine the preheat temperature if its carbon equivalent is higher than that of the plate | Room temperature is approx. 20 °C

MAXIMUM RECOMMENDED INTERPASS TEMPERATURE

Maximum recommended interpass temperature [°C]	
SIMAXX 700	225
SIMAXX 900	150–175
SIMAXX 1000	150–170

Welding recommendations are also available in EN 1011-2.

General guidelines for arc welding are available in EN 1011-1.



QUALITY DRIVEN

We test each plate to ensure consistent quality you can rely on.

TESTING AND CERTIFICATION

Mechanical properties are measured on each plate according to EN ISO 6506-1 or EN 10003-1. Tests are performed in an accredited in-house testing laboratory. Inspection certificate EN 10204/3.1 is issued for each delivery. By agreement, an inspection certificate EN 10204/3.2. by an independent inspection agency can be provided.

Additional ultrasonic testing according to EN 10160, A/SA435 or A/SA578 can be performed.



CUSTOMIZED WELDING CONSUMABLES FOR SIDUR AND SIMAXX STEELS

MORE THAN JUST STEEL – HIGHER EFFICIENCY THROUGH SIJ WELDING SOLUTIONS

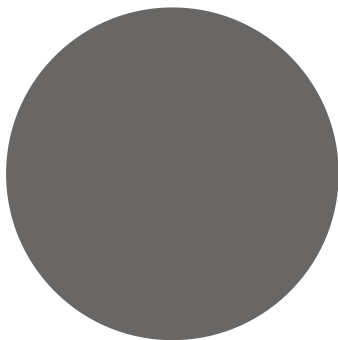
Within the SIJ Group we have developed special welding consumables to be used when welding SIDUR AND SIMAXX products. Long experience in the field of welding and expert knowledge enables us to offer more efficient welding solutions that can increase welding performance by up to 10 %* and essentially reduce the costs of production for our clients.

SIJ Group welding consumables produced by SIJ Elektrode are the perfect solution for welding SIJ Group steel products. Our welding consumables have been carefully developed, taking the characteristics of SIJ Group steels into consideration. As a result, we are able to offer optimization and cost reduction for your welding process. Our welding solutions are suitable even for the most demanding industries and applications.

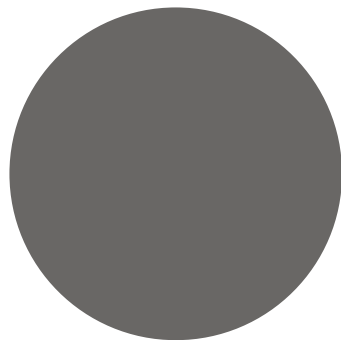
A smooth welding process and more precise welding flow results in a perfect joint welding structure.

* internal testing data

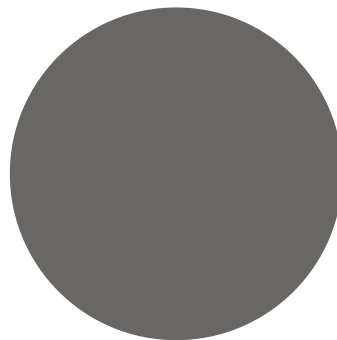
Our work is never truly done; we are a part of an endless process. This is symbolised by the **three dots** in our corporate logo and the logos of each SIJ Group product and service brand. **Three dots represent three values.** Each one stands firmly on its own, and they all stand together, forever. As a sign of trust and quality, they symbolise our three main values, which define who and what we are.



CUSTOMISATION.



DILIGENCE.



RELIABILITY.



**THE BEST THINGS IN THE WORLD
CONTAIN SLOVENIAN STEEL**



SIJ Group

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1000 Ljubljana

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