



**SIDUR**...

WEAR RESISTANT STEEL



**SIMAXX**...

HIGH STRENGTH STEEL



**sij**

Wear-resistant and high-strength steels  
**SIDUR | SIMAXX**





# sij | group

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](http://www.sij.si)



#### **INCREASE YOUR PRODUCT'S LIFE SPAN**

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



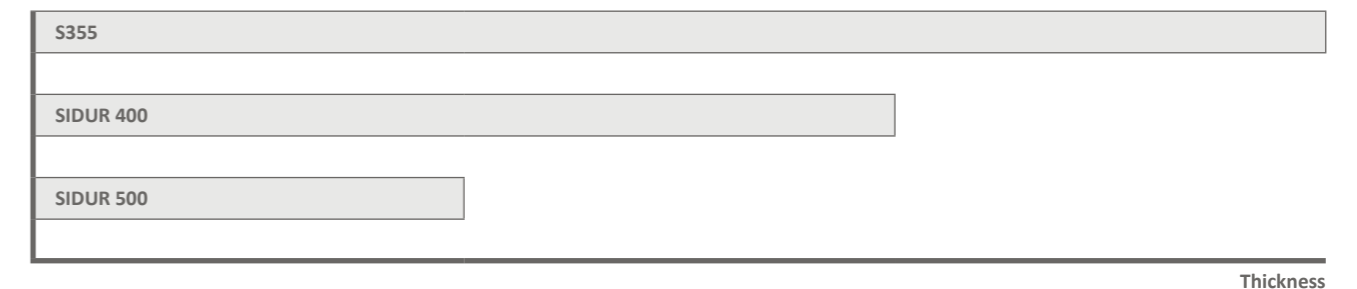
**SIDUR** is a highly wear-resistant steel of extreme hardness, strength, and toughness. This makes it durable and suitable for use in the most difficult environments where there is a risk of abrasion caused by contact with hard minerals and other abrasive materials. SIDUR steel is more durable than structural steel, resulting in products with a life span up to three times longer. In combination with its high wear-resistance, it also offers formidable weldability and machinability.

#### **SIDUR – EXTREME RESISTANCE TO ABRASIVE WEAR**

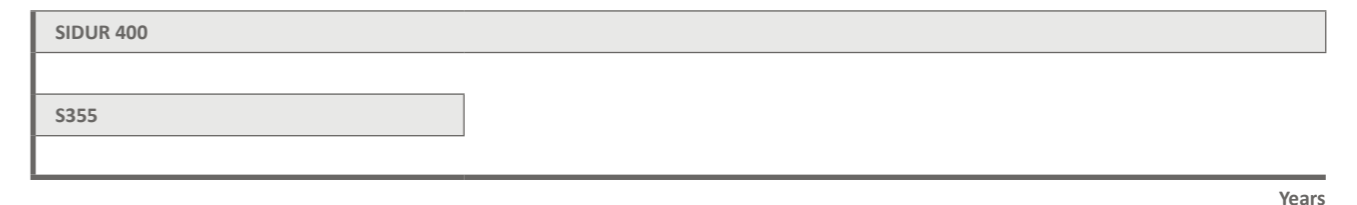
SIDUR steels are produced within a hardness range from 220 to 540 HBW. Compared to non-alloyed structural steels, SIDUR plates have higher durability which results in a lifespan of your products up to three times longer.

The unique combination of high hardness, high strength and good toughness improves bending, welding, and machining properties and deformation levels. SIDUR is a material well suited to a wide variety of applications where it will be exposed to heavy wear by hard minerals and other abrasive materials.

#### **BETTER PERFORMANCE AT LOWER THICKNESS**



#### **UP TO THREE TIMES LONGER LIFESPAN OF PRODUCTS**



#### **SPECIAL SIDUR GRADES**

##### **SIDUR 350 HI TEMP AND SIDUR 350 MACHINABILITY +**

– heat resistance in addition to abrasion resistance

SIDUR fine grain steel combines high resistance to mechanical wear and heat resistance up to 600°C with good weldability and machining.

##### **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 wear, hardness can be increased by three times compared to its condition at delivery.



## 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

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	0,8	0,5	0,5	0,004
SIDUR 450	0,27	1,0	1,5	0,002	0,012	0,8	0,5	0,5	0,004
SIDUR 500	0,29	1,0	1,5	0,002	0,012	1,0	0,5	0,5	0,005
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			

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

Grade\Thickness range	8-25mm	25-40mm	Above 40mm
Sidur 400	max 0,46	max 0,59	max 0,60
Sidur 450	max 0,49	max 0,59	max 0,74
Sidur 500	max 0,59	max 0,64	max 0,75

## HARDNESS HBW AND DELIVERY CONDITION

Hardness (HBW)	8-25mm	25-40mm	Above 40mm			
	SIDUR 300	SIDUR 400	SIDUR 450	SIDUR 500	SIDUR 350 hi temp	SIDUR 3401
220-277	260-340	360-440	420 - 477	460 - 540	Min. 300HB	Max. 240HB
Rolled	Rolled	Quenched and tempered	Quenched and tempered	Quenched and tempered	Normalized	Solution annealed

## 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 (MPa)	Tensile strength Rm (MPa)	Elongation (minimal) A5 (%)	Charpy V-Notch
SIDUR 250	750	940	15	-20°C 30J SIDUR 350 hi temp
SIDUR 300	820	1030	15	-20°C 30J Min. 300HB
SIDUR 400	900	1300	12	-20°C 30J Normalized
SIDUR 450	1100	1450	10	-20°C 30J
SIDUR 500	1300	1650	8	-20°C 25J
SIDUR 350 hi temp	660	1000	10	-20°C 27J
SIDUR 3401	350	800-1000	30	

Typical values for 15 mm plate thickness

\* orientational value

## DIMENSIONAL RANGE

		Thickness (mm)
	<b>SIDUR 400</b>	<b>110</b>
	SIDUR 450	100
	SIDUR 500	
	SIDUR 250	60
	SIDUR 300	
	SIDUR 600	
	X12	
		8
		5
Width (mm)		2500

	Thickness (mm)*	Width (mm)*	Length (mm)
<b>SIDUR 250</b>	8-60	1000-2500	2000-12000
<b>SIDUR 300</b>	8-60	1000-2500	2000-12000
<b>SIDUR 400</b>	8-110	1000-2500	2000-12000
<b>SIDUR 450</b>	8-100	1000-2500	2000-12000
<b>SIDUR 500</b>	8-100	1000-2500	2000-12000
<b>SIDUR 350 hi temp</b>	6-60	1000-2500	2000-12000
<b>SIDUR 3401</b>	2-60	1000-2500	2000-12000

\*According to agreement

## TOLERANCES

On request, narrower thickness, shape, length, width and flatness tolerances as according to EN 10 029 are available.

## SURFACE PROPERTIES

According to EN 10 163/A-1.

Anticorrosive primer red oxide color on request.

## SIDUR IN A WORKSHOP

### BENDING

	R/t			W/t		
	Thickness	Transverse	Longitudinal	Transverse	Longitudinal	Springback
<b>SIDUR 400</b>	8 ≥ t < 20	3,0	4,0	10,0	10,0	9-13
	t ≥ 20	4,5	5,0	12,0	12,0	
<b>SIDUR 450</b>	8 ≥ t < 20	4,0	5,0	10,0	12,0	11-18
	t ≥ 20	5,0	6,0	12,0	14,0	
<b>SIDUR 500</b>	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.

### CUTTING

SIDUR can be cut using thermal cutting processes or by using cold methods of shearing, water-jet etc. When cutting thicker plates of SIDUR, especially when using oxy-fuel, special care must be taken before and after the cutting process to prevent (delayed) cut edge cracking. Preheating the plates is one of most important solutions before cutting. Additional post heating of the cut edge is also carried out where necessary to reduce residual stresses. 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	Min. 3 min/mm at soaking temperature		-	-
Soaking time in minutes per mm:	-	Min. 3 min/mm at temperature	-	-
Cooling method:	insulating blanket / warm pilling / furnace		-	-
<b>If blow-pipe system is used temperature measurement should be done on the opposite side of the plate.</b>				

## WELDING SIDUR

Welding process or procedure*	Welding materials / Welding process	EN Designation (EN 499, EN 757, EN 1600, EN 440, EN 14700 EN 758, EN 12071, EN 756, EN 760)	SIJ Elektrode Designation	SIJ Acroni Wear Resistant Plate Grade	SIDUR	SIDUR	SIDUR	SIDUR	SIDUR	SIDUR	SIDUR
					250	300	400	450	500	350 hi	3401
Welding	SAW Flu•es / 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	E 42 4 B 32 H5	EVB 50	•	•	•	•				
	MMAW	E 42 6 B 42 H5	EVB 55	•	•	•	•	•			
	Flu• cored wires	T 46 4 M M 1 H5	Filtub 12M	•	•	•	•				
	FCAW	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 MMAW	E 692MN2NiCrMoB42	EVB 75		•	•	•	•			
	Electrodes	E 692MN2NiCrMoB42	EVB 80		•	•	•	•	•		
	MMAW	E 89AMn2NiCrMoB42	EVB 100			•	•	•	•		
	Flu• cored wires	T 69 4 Mn 2Ni Cr Mo M 1 H5	Filtub 32M			•	•	•	•		
	FCAW	T 69 6 Mn2NiCrMo B M (C)3 H5	Filtub 32B			•	•	•	•		
	Wires GMAW, GTAW	Mn3Ni1CrMo	MIG 75		•	•	•	•	•		
Hardfacing	Electrodes	Fe 1	E DUR 250	•							
			E DUR 300		•						
	MMAW	Fe 2	E DUR 500						•		
		Fe 3	E DUR 400			•	•				
		Fe 8	E DUR 600							•	
	Flu• cored wires	Fe 1	Filtub DUR 3	•	•						
			Filtub DUR 5		•	•	•				
	FCAW	~Fe 3	Filtub DUR 12/ DUR16			•	•		•	•	
		E 307 T0-1	FILCORD 307								•
Interlayer	Electrodes MMAW	E 18 8 Mn B 22	Ino• B 18/8/6	•	•	•	•	•	•	•	
	Wires GMAW, GTAW	G 18 8 Mn	MIG/ TIG 18/8/6Si	•	•	•	•	•	•	•	•
	SAW Flu•es / Wires	SA AF 2 54 DC/ S 18 8 Mn	FB33/ EPP 18/8/6	•	•	•	•	•	•	•	

## RECOMMENDED WELDING PROCEDURES

- For SIDUR steels in combination with unalloyed materials types S355, we recommend welding materials marked with \*
- 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.
- 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

## MAXIMUM RECOMMENDED PREHEAT TEMPERATURE

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

\* for thicknesses up to 13mm | 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.

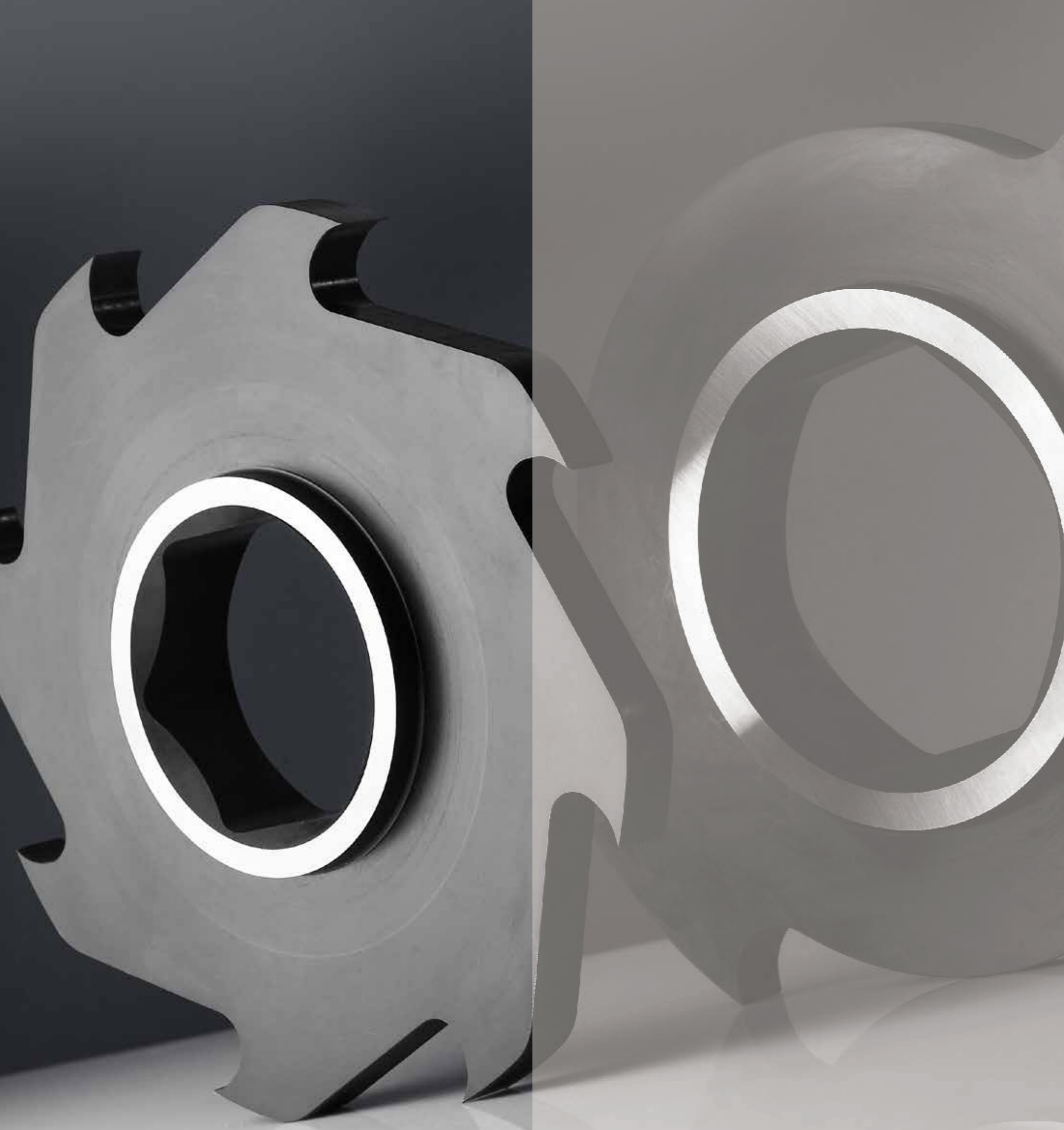
In these cases the recommended preheat temperature during infusions should not exceed 200°C as this can cause reduction in hardness. Welding should be carried out immediately after the welding edges have been finished, to avoid surface contamination.

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.



#### 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 required, the choice of appropriate material is crucial. SIDUR, viewed from the perspective of mechanical treatment, 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 – 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, Ravne Knives.

# SIMAXX<sup>...</sup>



**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.

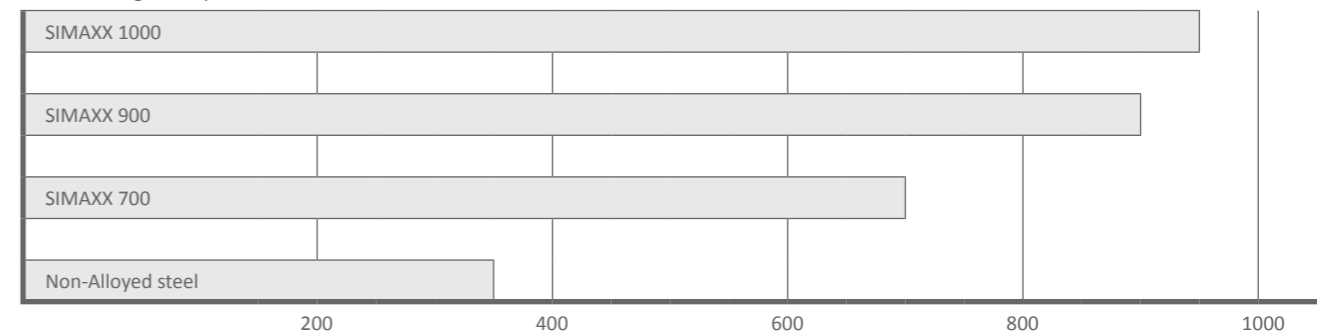
Compared to unalloyed structural steel, SIMAXX achieves better results at lower thicknesses, making elevators, vehicles and similar products lighter and able to carry more weight. The thinner plates are also less demanding to weld, thus cutting costs, improving the work process, and increasing your productivity.

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.

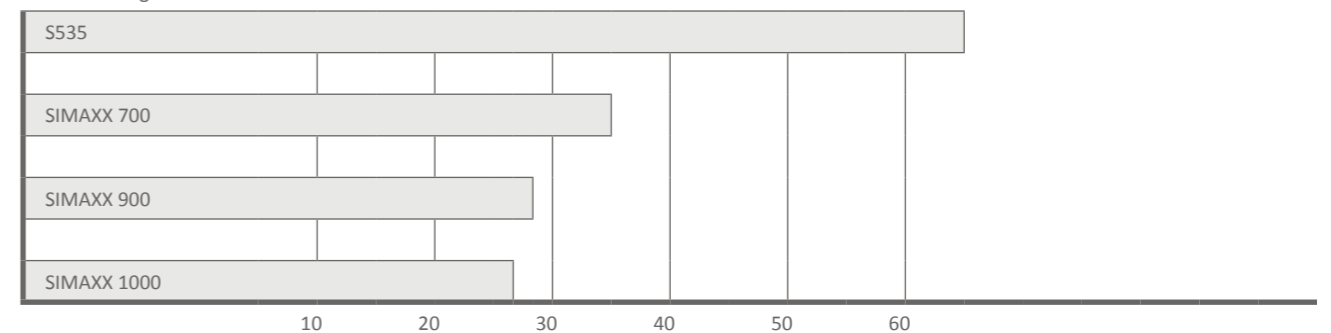


**SIMAXX<sup>...</sup>**

Yield strength comparison



Same strength 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

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	0,80	0,45	0,005
SIMAXX 900	0,18	0,5	1,5	0,002	0,012	1	0,50	0,5	0,005
SIMAXX 1000	0,19	0,5	1,6	0,002	0,012	1,2	0,50	0,6	0,005

## MECHANICAL PROPERTIES

	Yield strength (minimal) Re (MPa)	Tensile strength Rm (MPa)	Elongation (minimal) A <sub>5</sub> (%)
SIMAXX 700	690	770-940	14
SIMAXX 900	890	940-1100	11
SIMAXX 1000	960	1000-1150	10

Values valid for plates up to 50 mm in thickness. According to EN 10025-6 (2004) + A1 (2009)

## IMPACT PROPERTIES

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

According to EN 10025-6 (2004) + A1 (2009)

## DELIVERY CONDITIONS

Quenched and tempered (Q + T)

Quenched and tempered + shotblasted + primed

## DIMENSIONAL RANGE

	Thickness (mm)
SIMAXX 700	100
SIMAXX 900 SIMAXX 1000	60
	8
Width (mm)	2500

	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

## TOLERANCES

On request, narrower thickness, shape, length, width and flatness tolerances as according to EN 10 029 are available.

## SURFACE PROPERTIES

According to EN 10 163/A-1.

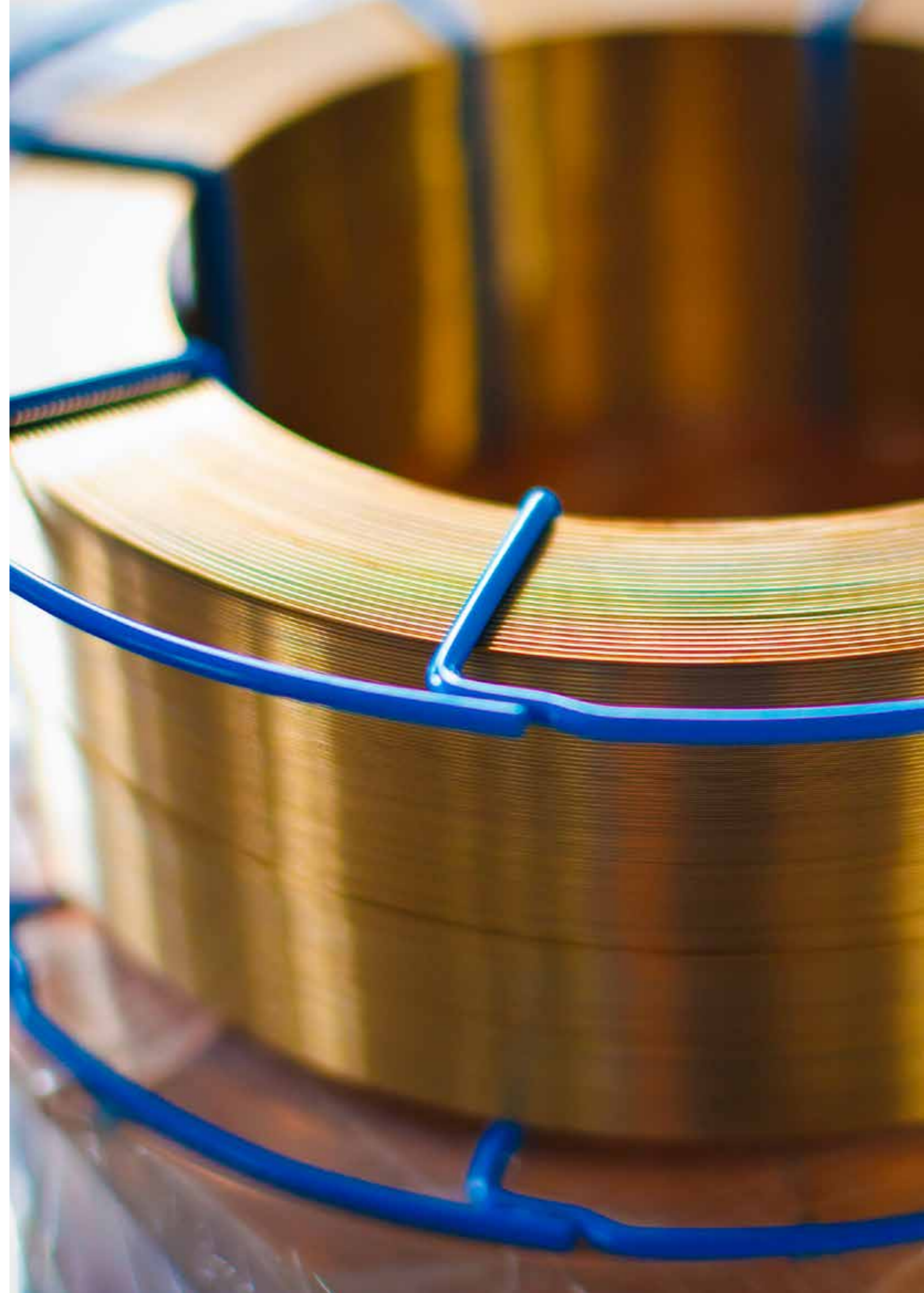
Anticorrosive primer red oxide color upon request.

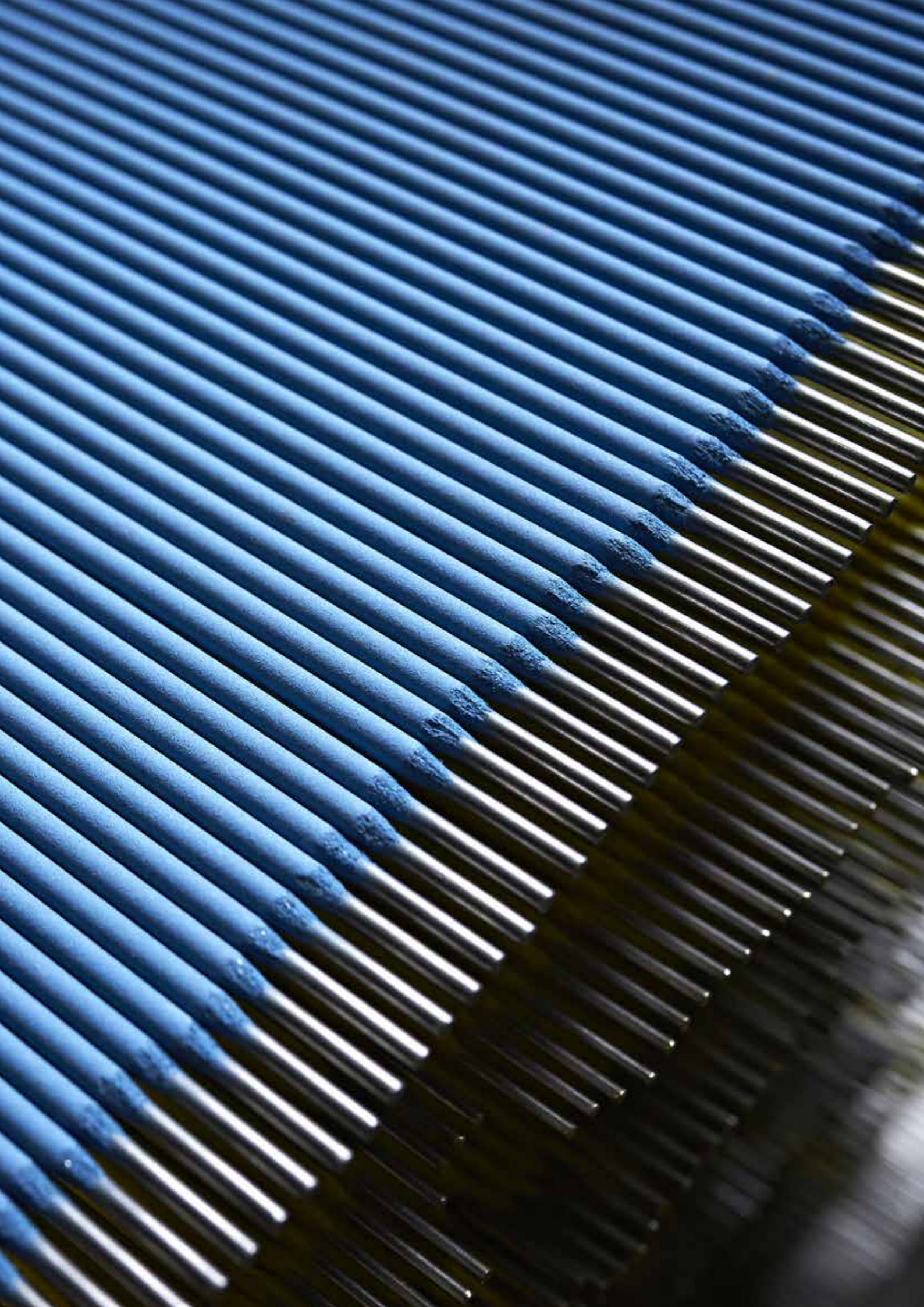
## SIMAXX IN A WORKSHOP

## BENDING

	Thickness	R/t		W/t		Springback
		Transverse	Longitudinal	Transverse	Longitudinal	
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 being bent to 90° along the direction 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 499, EN 757, EN 440, EN 758, EN 12535, EN 12534, EN 760)	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		•	•

SIJ Acroni SIMAXX high strength heavy plates as high strength low alloyed steels (HSLA) with elevated yield strength have good weldability, but correct welding procedure should be followed.

Root-welding passes should be welded with softer filler materials (under matching), filling and cover passes with similar fine-grained welding materials- see the table.

When welding SIMMAX steels with unalloyed materials can be done using materials dedicated for unalloyed steels.

For welding Acroni SIMAXX steels, welding with low energy input is recommended, which involves an optimum welding current and welding with more passes. When welding with too high energy input can result in an increase of crystal grains in the HAZ (heat affected zone), which greatly deteriorates mechanical properties.

Our experts recommend welding immediately after the welding edges have been finished, to avoid contamination. Coated electrodes must be dried before welding.

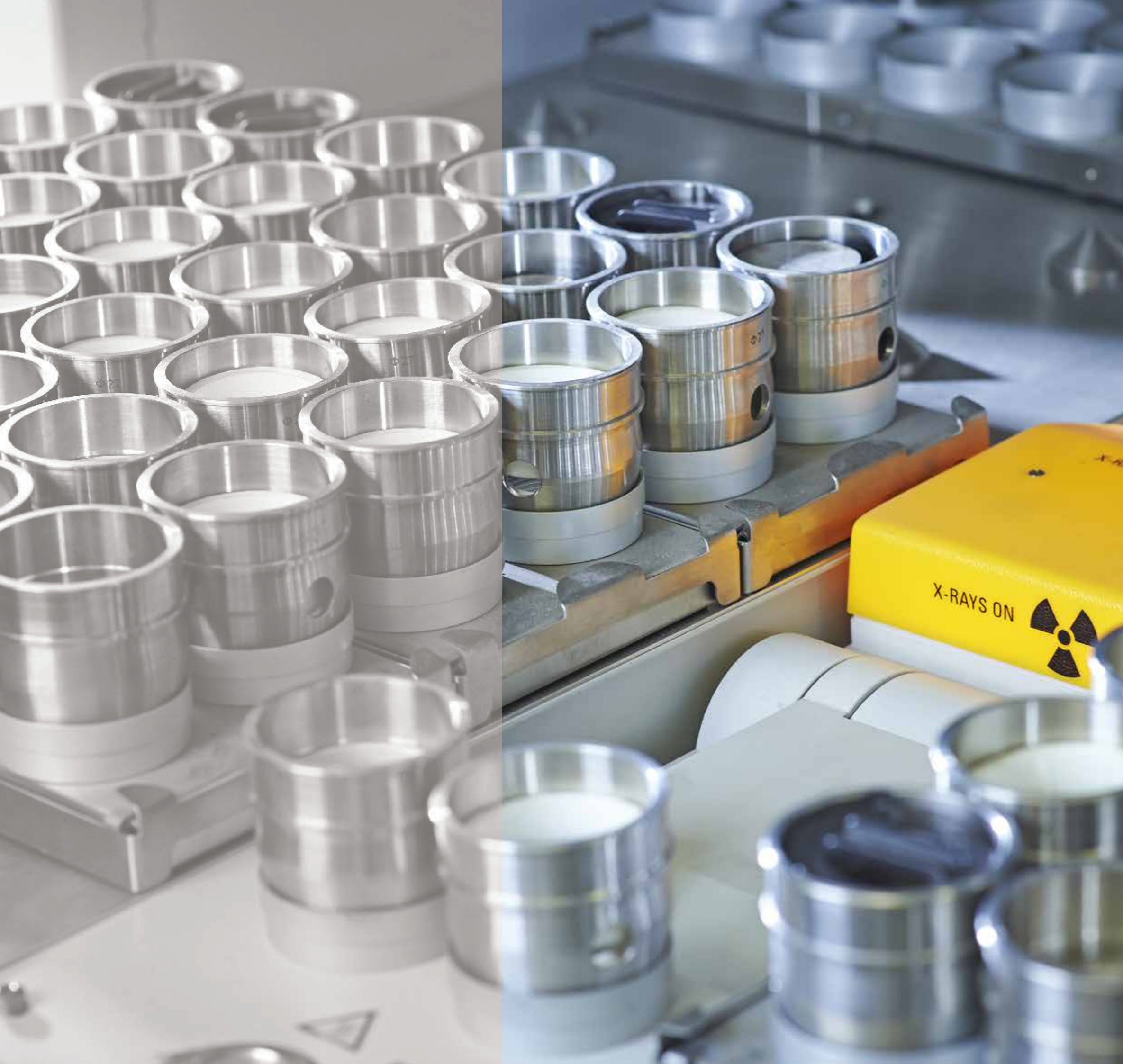
## MAXIMUM RECOMMENDED PREHEAT TEMPERATURE

Maximum 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 13mm | 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]	
SIMAXX 700	225
SIMAXX 900	150–175
SIMAXX 1000	150–170



#### **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**

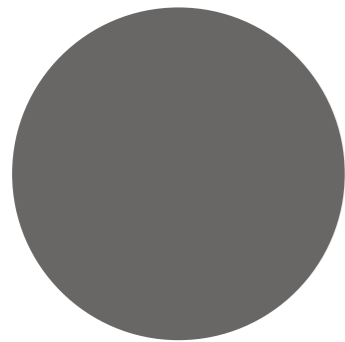
Within the SIJ Group we have developed special welding consumables to be used when welding SIDUR AND SIMAXX products. Long experience in the field of welding and expert knowledge enables us to offer more efficient welding solutions that can increase welding performance by up to 10%\* and essentially 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 steel into consideration. As a result, we are able to offer optimization and cost reduction for your welding process. Our welding solutions are suitable for even the most demanding industries and applications.

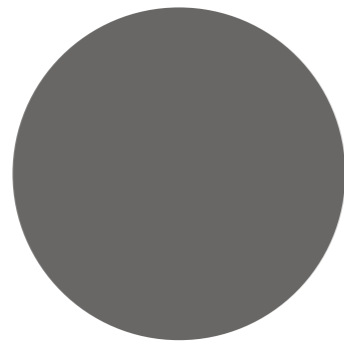
A smooth welding process and more precise welding flow results in a perfect joint welding structure.

\* internal testing data

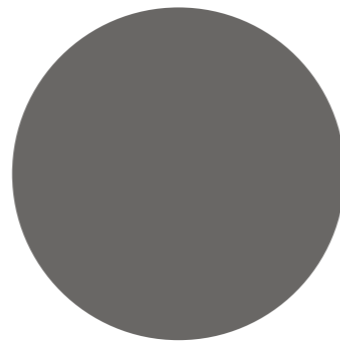
Our work is never truly done; we are a part of an endless process. This is symbolised by the **three dots** in our corporate logo, and the logos of each SIJ Group product and service brand. **Three dots equals three values.** Each one stands firmly on its own, and they all stand together, forever. As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



**CUSTOMISATION.**



**STRIVING.**



**PROVEN.**

**sij** | group



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



**SIJ Group**

Gerbičeva 98  
1000 Ljubljana  
[www.sij.si](http://www.sij.si)