

The name you can trust

sij | metal ravne

sij | group



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KEY FACTS:

- **400 YEARS TRADITION**
 - **EMPHASIS ON STRONG RESEARCH AND DEVELOPMENT**
 - **OVER 200 STEEL GRADES**
 - **80.000 T ANNUAL STEEL PRODUCTION**
 - **GLOBALLY EXPANDED SALES NETWORK**
 - **PART OF SIJ – SLOVENIAN STEEL GROUP**
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ABOUT SIJ METAL RAVNE

SIJ METAL RAVNE IS PRODUCING PREMIUM QUALITY **TOOL, HIGH-SPEED STEELS AND STAINLESS & SPECIAL STEELS.**

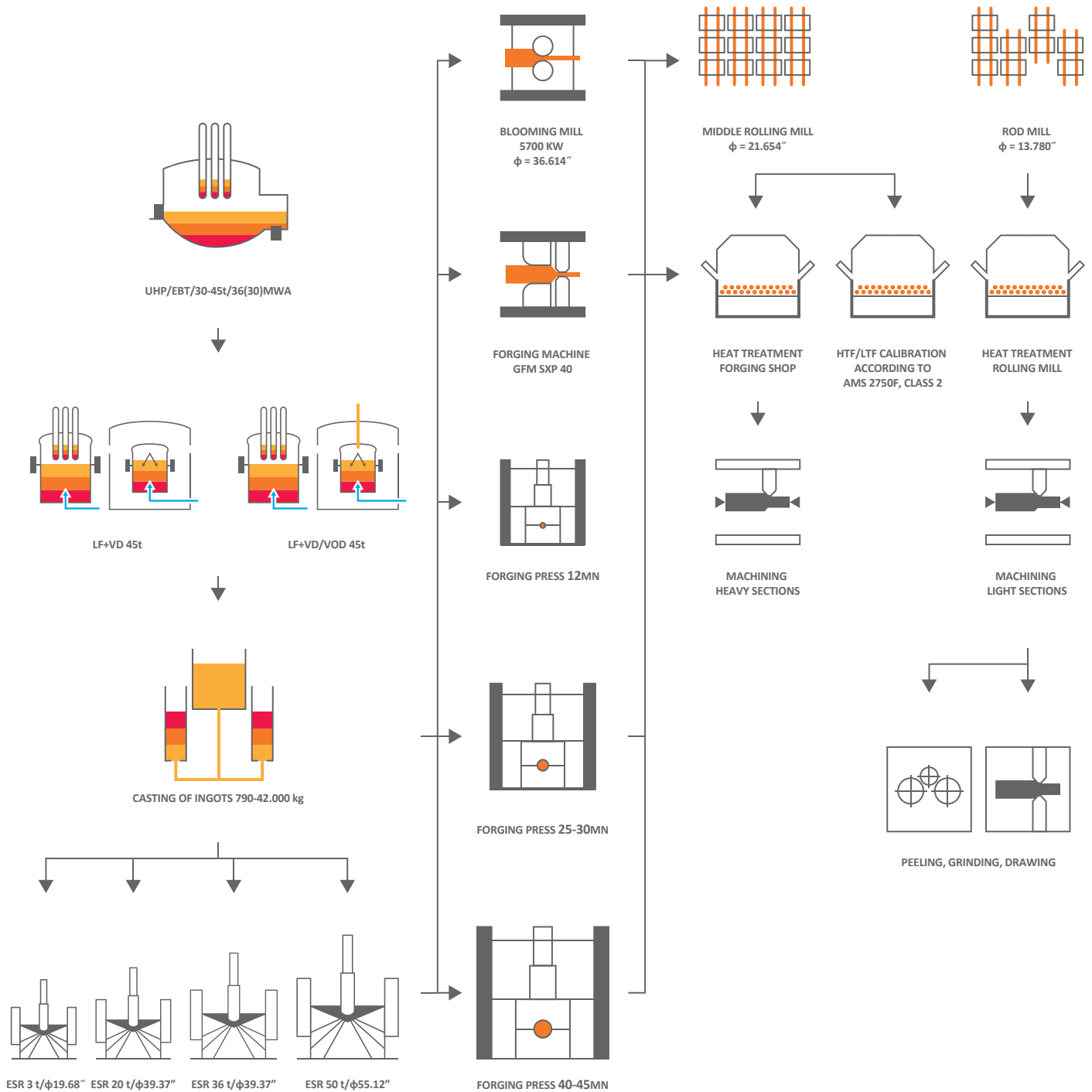
We produce steel in an electric arc furnace, casting it into ingots and rolling or forging into quality long steel products. For the most challenging conditions we use VOD* and ESR** methods. Our own Steel Plant, Forging Shop, Rolling Mill and a wide range of heat treatment and machining processes allow us to produce a rich pallet of more than 200 steel grades in different dimensional shapes.

With 1.050 employees and almost 80.000 ton annual production we belong globally to the group of mini mills. Therefore, we found our opportunity in the so called niche production which is characterized by specific knowledge and experience, larger flexibility and higher added value.

* VOD (Vacuum Oxygen Decarburization) is a process for refinement of stainless steel through reduction of carbon content under vacuum.

** ESR (electro-slag remelting) is a remelting and refining procedure of steel and other alloys for use in the most demanding industries (tool industry, energy industry, automotive industry, aviation industry, and similar).

PRODUCTION PROGRAM





ROLLING PROGRAM

THIS PROGRAM ENABLES US TO PRODUCE A VERY WIDE SPECTRUM OF PRODUCTS WITH DIFFERENT SURFACE MACHINING FINISH AND VARIOUS FINAL HEAT TREATMENT CONDITIONS.

THE ROLLING PROGRAM JOINS THREE PRODUCTION UNITS:

**BILLET ROLLING MILL,
SECTION ROLLING MILL AND
STEEL DRAWING PLANT.**

The Billet Rolling Mill uses a modern Blooming rolling stand in addition to many modern heat treatment furnaces and grinding and testing machines.

The Section Rolling Mill can produce round, square and flat sections of various dimensions in its Intermediate Rolling Mill and Rod Mill.

In addition, we have modern heat treatment furnaces; machines for straightening, cutting, sandblasting, varnishing operations and for inspection of rolled products.

The Steel Drawing Plant produces products with a drawn, peeled or ground surface.

BILLETS AND ROLLED PRODUCTS

STANDARD DIMENSIONAL PRODUCTION & SALES PROGRAM:

BILLETS WITH ROUNDED EDGES – TOLERANCE +/-3%

- Square 3.346" – 8.661"
- Flat 5.945" – 12.598" × 2.756" – 5.118"
- Length: 78.74" – 216.54"

WIDE FLAT SECTIONS:

- Width milled: tolerance +0.078"/-0", thickness rolled: tolerance +0.157"/-0"
- Width and thickness milled: tolerance + 0.078"/- 0"
- Length: 62.99" – 177.17"

WIDTH x THICKNESS:

- 3.346" – 5.906" × 2.756" – 5.118"
- 5.945" – 9.843" × 2.756" – 3.543"
- 9.882" – 19.882" × 0.984" – 3.543"



BILLETS AND ROLLED PRODUCTS

ROUND SECTIONS

(ACC. TO EN 10060 STANDARD)

- Bars: ϕ 0.591" – 4.134"
- Length: 118.11" – 236.22"
- Surface finish: the surface can be unmachined or roughly peeled. Roughly peeled products are made in dimensions ϕ 1.181"–3.976" and in tolerance $\pm 0.011"$ (+ 0.024"/– 0"); if very narrow tolerance is requested, + 0.019"/– 0" is applied.
- Tolerances for the unmachined version are evident from the table below.
- Achieved straightness of $\leq \frac{1}{8}" / 5$ ft (valid for all surfaces).

TOLERANCES FOR ROUND UNMACHINED SECTIONS

DIMENSION "	TOLERANCE "	DIMENSION "	TOLERANCE "	DIMENSION "	TOLERANCE "
0.591	± 0.016	1.417	± 0.031	2.441	± 0.039
0.630	± 0.020	1.457		2.480	
0.670		1.496		2.520	
0.709		1.535		2.559	
0.748		1.575		2.598	
0.787		1.614		2.677	
0.827		1.654		2.756	
0.866		1.693		2.835	
0.906		1.732		2.874	
0.945		1.772		2.953	
0.984		1.811		3.071	
1.024		1.850		3.150	
1.063		1.929		3.228	
1.102		1.969		3.268	
1.142		± 0.024	2.008	± 0.039	3.346
1.181	2.047		3.467		
1.220	2.087		3.504		
1.260	2.126		3.543		
1.299	2.165		3.622		
1.339	2.205		3.661		
1.378	2.283		3.701		
	2.362		3.740		
			3.819		
			3.937		
		4.055	± 0.059		
		4.134			

BILLETS AND ROLLED PRODUCTS

SQUARE SECTIONS

(ACC. TO EN 10059 STANDARD)

- Square: 0.984" – 2.953"
- Length: 118.11" – 236.22"
- Tolerance: see the table below
- Achieved straightness of $\leq \frac{1}{8}" / 5 \text{ ft}$

TOLERANCES FOR SQUARE SECTIONS

DIMENSION "	TOLERANCE "	ROUNDNESS OF EDGES "	DIMENSION "	TOLERANCE "	ROUNDNESS OF EDGES "
0.984 x 0.984	±0.020	r ≤ 0.079	1.575 x 1.575	±0.031	r ≤ 0.0984
1.024 x 1.024	±0.024		1.654 x 1.654		
1.102 x 1.102			1.772 x 1.772		
1.181 x 1.181			1.969 x 1.969		
1.250 x 1.250		r ≤ 0.0984	2.047 x 2.047	±0.039	r ≤ 0.118
1.378 x 1.378			2.165 x 2.165		
1.417 x 1.417			2.362 x 2.362		
1.457 x 1.457			2.559 x 2.559		
1.496 x 1.496			2.756 x 2.756		
		2.953 x 2.953			

Sections can be made in plus tolerance only, in plus/minus tolerance or in minus tolerance only.

Intermediate dimensions (by 0.039" increments) can be produced.

BILLETS AND ROLLED PRODUCTS

FLAT SECTIONS

(ACC. TO EN 10058 AND 59200 STANDARD):

- Width 1.575" – 5.906" with thickness 0.276" – 2.559"
- Width 5.90" – 10.039" with thickness 0.276" – 1.969"
- Ratio: for tool steels 1:15, for structural steels 1:18
- Width: minimal thickness + 0.397" (applies to all steels except for high-speed steels)
- Length: 118.11" – 236.22"
- Surface finish: surface can be unmachined, sandblasted or varnished.
- Tolerance: see the table below.
- Achieved straightness of $\leq \frac{1}{8}'' / 5 \text{ ft}$

TOLERANCES FOR FLAT SECTIONS

	WIDTH "	TOLERANCE "
WIDTH ≤ 5.906" (acc. to EN 10058 standard)	b = 1.575	±0.030
	1.575 < b ≤ 3.150	±0.039
	3.150 < b ≤ 3.937	±0.059
	3.937 < b ≤ 4.724	±0.079
	4.724 < b ≤ 5.906	±0.098
	THICKNESS (")	TOLERANCE (")
	d < 0.787	±0.020
	0.787 < d ≤ 1.575	±0.039
	1.575 < d ≤ 1.969	±0.059
WIDTH > 5.906" (acc. to EN 59200 standard)	WIDTH (")	TOLERANCE (")
	5.906 < d ≤ 9.843	±2 % width
	THICKNESS (")	TOLERANCE (")
	0.787 < b ≤ 0.984	-0.020/+0.035
	0.984 < b ≤ 1.181	-0.024/+0.039
	1.181 < b ≤ 1.575	-0.028/+0.043
	1.575 < b ≤ 1.969	-0.035/+0.043

Table provides standard tolerances. Sections can be also made in very narrow tolerances, per width $\frac{1}{4}$ and per thickness $\frac{1}{2}$ tolerance from the above table. Sections can be made only in plus tolerance, in plus/minus tolerance or only in minus tolerance.

ROLLED PRODUCTS – BRIGHT SECTIONS

Peeled and peeled & polished bars (acc. to EN 10278 standard)

- Bars: ϕ 0.630" – 3.150"
- Length: 98.43" – 236.22"

Ground and ground & polished bars (acc. to EN 10278)

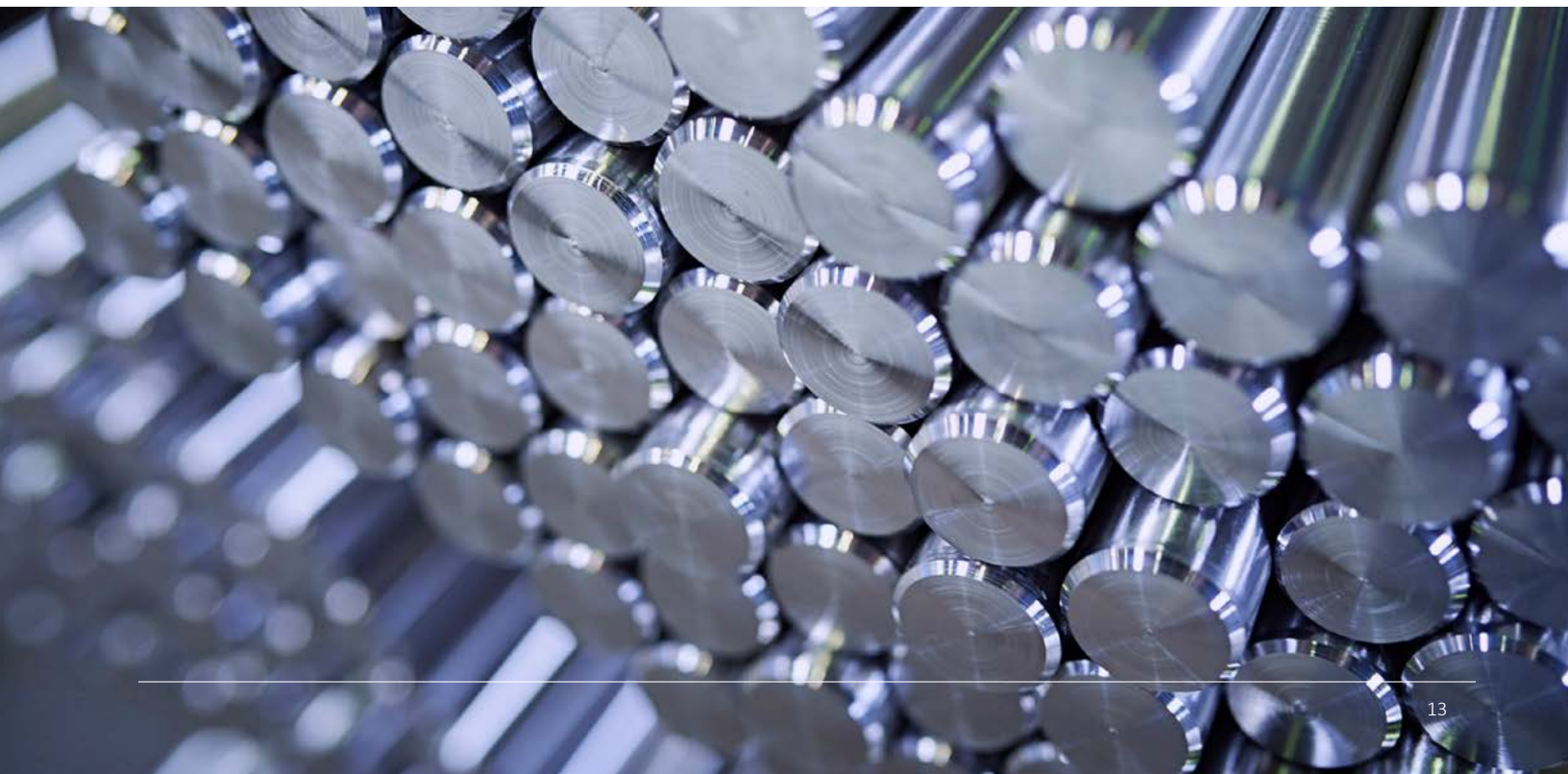
- Bars: ϕ 0.236" – 3.149"
- Length: 78.74" – 157.48"

TOLERANCES FOR BRIGHT SECTIONS

NOMINAL DIMENSION "	TOLERANCE		
	h8*	h9	h11
$> 0.236 \leq 0.394$	0,022	0,036	0,090
$> 0.394 \leq 0.709$	0,027	0,043	0,110
$> 0.394 \leq 1,181$	0,033	0,052	0,130
$> 1.181 \leq 1,969$	0,039	0,062	0,160
$> 1.969 \leq 3,150$	0,046	0,074	0,190

*Valid only for ground and ground&polished bars max. ϕ 1.969".

In addition to these tolerances: f, k, a, g, j.





FORGING PROGRAM

THIS PROGRAM INCLUDES THE BASIC FORGING EQUIPMENT AND ALL OTHER NECESSARY DEVICES FOR THE PRODUCTION OF VARIOUS FORGING PRODUCTS.

FORGING PROGRAM PRODUCTS:

- **BILLETS**
- **FORGED BARS**
- **OPEN-DIE MACHINED FORGINGS**

For smaller dimensions, we use the SX-40 forging machine, while larger ones are made on presses. We have 12 MN, 25 MN and 40 MN presses.

All these products can be subjected to heat treatment in modern heat treatment furnaces using different procedures.

In 2021, we invested in a special line for heat treatment of products used in the most demanding industries, such as the energy industry, aviation industry, oil and gas industry, and others. The line consists of two double-chambered furnaces. The individual “twins” include a high-temperature and low-temperature chamber. In addition to the furnace, the line consists of two cooling pools and a portal manipulator with up to 25 tonnes of load that provides accurate product stocking. Precision is assured with AMS 2750 F standard certification.

The important part of our Forging Program involves machines for machining and cutting of material.

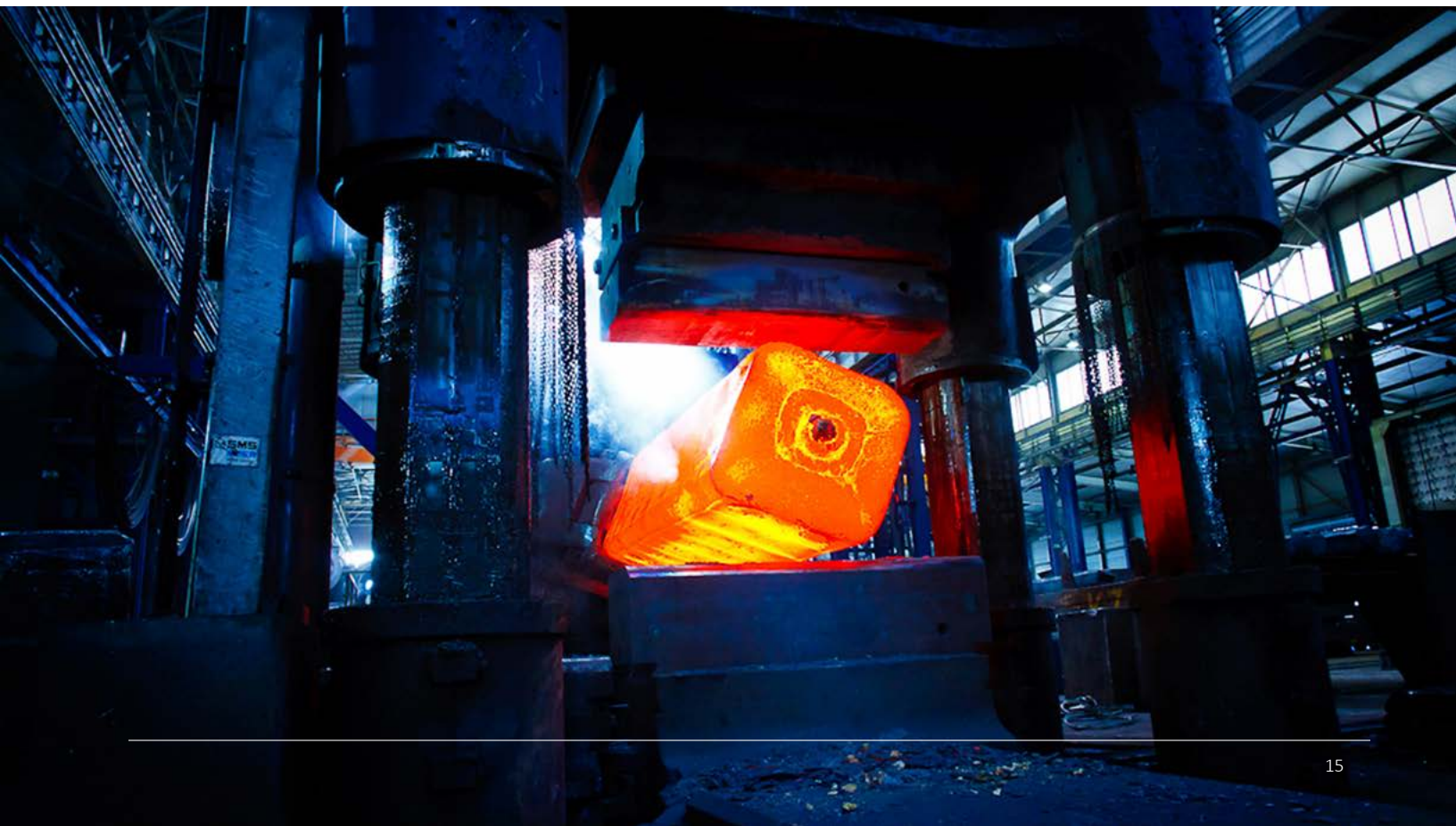
Beside black-surfaced products, we also provide products with light surface after the peeling, turning, and milling processes. We also offer cutting to the requested dimensions.

FORGED PRODUCTS

BILLETS

(PRODUCT USED FOR FURTHER HOT FORMING):

- Round: ϕ 3.543" – 39.370"
- Square: sq. 3.543" – 35.433"
- Length: 78.74" – 393.70"
- Tolerances:
 - tool steel from ϕ 3.543" – 7.874" \pm 0.1970", other steels \pm 0.394"
 - tool steel from sq. 3.543" – 7.874" \pm 0.197", other steels \pm 0.394"
 - from ϕ 7.913" – 11.811" \pm 0.236", sq. 7.913" – 11.811" \pm 0.591"
 - over ϕ 11.850" \pm 0.394", sq. over 11.850" \pm 0.787"



FORGED PRODUCTS

FORGED BARS

(ACC. TO DIN 7527/6 STANDARD):

ROUND FORGED BARS:

- ϕ 3.543" – 37.402"
- Length: 78.74" – 393.70"
- Surface can be unmachined, peeled or turned:
 - **Peeled surface:**
 - ϕ 3.346" – 8.071": tolerance +0.039/– 0"
 - **Turned surface:**
 - ϕ 8.110" – 39.370"
 - ϕ 8.110" – 11.811": tolerance +0.079/– 0"
 - ϕ 11.850" – 39.370": tolerance +0.118/– 0"
 - **Max. weight of forging:**
 - turned forgings max. 39683 lbs, length 236.22", cross section up to ϕ 43.307"
 - conventional (unmachined): 55116 lbs
 - ESR: max. 50706 lbs

FLAT FORGED BARS:

- From 3.150" × 2.756" to 10.236" × 4.724" or 10.276" × 3.150" to 62.992" × 25.590"
- Length: 78.74" – 275.59"
- Surface finish: unmachined or milled.
Milled in tolerance: + 0.079/– 0".

SQUARE FORGED BARS:

- 3.150" – 33.465"
- Length: 78.74" – 275.59"
- Surface finish: unmachined or milled.
Milled in tolerance: + 0.079/– 0"

FORGED PRODUCTS

DIMENSIONAL PROGRAM DEPENDING ON STEEL GROUP

(FORGED DIMENSIONS)

GROUP 1:

UNALLOYED STRUCTURAL STEELS:

round: max. ϕ 39.370"

square: max. sq. 35.433"

flat: max. 62.992" x 25.590"

(max. ratio – width : thickness is 11:1).

GROUP 2:

ALLOYED STRUCTURAL STEELS:

round: max. ϕ 37.402"

square: max. sq. 33.465"

flat: max. 62.992" x 23.622"

(max. ratio – width : thickness is 11:1).

GROUP 3:

LOW-ALLOYED TOOL STEELS:

round: max. ϕ 33.465"

square: max. sq. 29.528"

flat: max. 61.024" x 21.654"

(max. ratio – width : thickness is 11:1).

GROUP 4:

HIGH-ALLOYED COLD-WORK TOOL STEELS:

round: max. ϕ 24.6063"

square: max. sq. 21.6535"

flat: max. 39.370" x 11.811"

(max. ratio – width : thickness is 8:1).

GROUP 5:

HIGH-ALLOYED HOT-WORK TOOL STEELS:

round: max. ϕ 33.465"

square: max. sq. 29.528"

flat: max. 59.055" x 17.716"

(max. ratio – width : thickness is 10:1)

GROUP 6:

HIGH-SPEED STEELS:

round: max. ϕ 7.087"

square: max. sq. 6.299"

flat: max. 9.843" x 3.937"

(max. ratio – width : thickness is 4:1).

GROUP 7:

SPECIAL STEELS:

round: max. ϕ 27.559"

square: max. sq. 25.591"

flat: max. 47.244" x 11.811"

(max. ratio – width : thickness is 8:1).

Larger dimensions according to agreement.



FORGED PRODUCTS

TOLERANCES AND ADDITIONS (ACC. TO DIN 7527/BL.6 STANDARD)

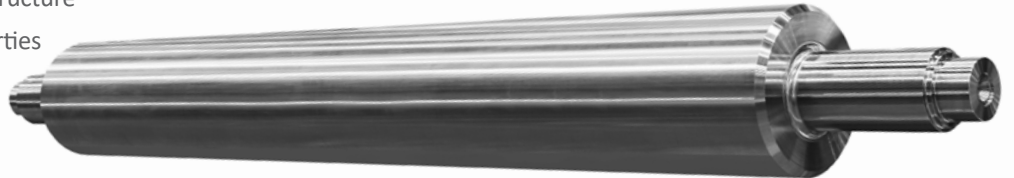
FINISHED DIMENSIONS "		HIGH-GRADE STEEL								LOW-GRADE STEEL			
		TOOL STEEL				STRUCTURAL STEEL				ALLOYED AND UNALLOYED STEEL			
		Length up to 137,80"		Length over 137,80" to 236,22"		Length up to 137,80"		Length over 137,80" to 236,22"		Length up to 137,80"		Length over 137,80" to 196,85"	
		Cross-section	Length	Cross-section	Length	Cross-section	Length	Cross-section	Length	Cross-section	Length	Cross-section	Length
OVER	UP TO	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	Acceptable tolerance	
0.630	0.984	0.102 ±0.024	0.354 ^{+0.394} _{-0.276}	/ /	/ /	/ /	/ /	/ /	/ /	/ /	/ /	/ /	
0.984	1.575	0.118 ±0.028	0.354 ^{+0.394} _{-0.315}	/ /	/ /	0.197 ±0.035	0.433 ^{+0.394} _{-0.315}	0.315 ±0.102	0.630 ^{+0.551} _{-0.354}	/ /	/ /	/ /	
1.575	2.480	0.158 ±0.035	0.394 ^{+0.433} _{-0.315}	0.236 ±0.055	0.551 ^{+0.433} _{-0.354}	0.236 ±0.043	0.472 ^{+0.433} _{-0.315}	0.354 ±0.114	0.669 ^{+0.551} _{-0.394}	0.354 ±0.110	0.512 ^{+0.512} _{-0.354}	/ /	
2.480	3.150	0.197 ±0.043	0.433 ^{+0.472} _{-0.354}	0.276 ±0.063	0.591 ^{+0.472} _{-0.394}	0.276 ±0.055	0.551 ^{+0.472} _{-0.354}	0.433 ±0.130	0.709 ^{+0.551} _{-0.433}	0.433 ±0.122	0.591 ^{+0.551} _{-0.354}	0.551 ±0.158	
3.150	3.937	0.236 ±0.051	0.472 ^{+0.512} _{-0.354}	0.315 ±0.075	0.630 ^{+0.512} _{-0.394}	0.315 ±0.067	0.591 ^{+0.512} _{-0.354}	0.472 ±0.142	0.787 ^{+0.669} _{-0.433}	0.472 ±0.134	0.630 ^{+0.630} _{-0.394}	0.591 ±0.173	
3.937	4.921	0.276 ±0.059	0.551 ^{+0.551} _{-0.433}	0.394 ±0.083	0.669 ^{+0.551} _{-0.394}	0.394 ±0.079	0.630 ^{+0.551} _{-0.433}	0.512 ±0.157	0.827 ^{+0.709} _{-0.472}	0.551 ±0.150	0.669 ^{+0.669} _{-0.394}	0.669 ±0.189	
4.921	6.299	0.354 ±0.070	0.591 ^{+0.551} _{-0.433}	0.472 ±0.098	0.748 ^{+0.591} _{-0.472}	0.472 ±0.091	0.709 ^{+0.551} _{-0.433}	0.591 ±0.181	0.866 ^{+0.787} _{-0.512}	0.630 ±0.165	0.748 ^{+0.709} _{-0.433}	0.748 ±0.213	
6.299	7.874	0.433 ±0.087	0.669 ^{+0.551} _{-0.551}	0.551 ±0.114	0.827 ^{+0.630} _{-0.551}	0.551 ±0.110	0.787 ^{+0.551} _{-0.551}	0.709 ±0.205	0.984 ^{+0.866} _{-0.551}	0.709 ±0.193	0.866 ^{+0.787} _{-0.512}	0.827 ±0.248	
7.874	9.843	0.512 ±0.102	0.787 ^{+0.630} _{-0.630}	0.669 ±0.138	0.906 ^{+0.669} _{-0.669}	0.669 ±0.134	0.906 ^{+0.630} _{-0.630}	0.827 ±0.236	1.063 ^{+0.945} _{-0.630}	0.827 ±0.220	0.945 ^{+0.866} _{-0.551}	0.945 ±0.283	
9.843	12.402	0.630 ±0.126	0.906 ^{+0.709} _{-0.709}	0.827 ±0.165	1.024 ^{+0.748} _{-0.748}	0.827 ±0.165	1.024 ^{+0.709} _{-0.709}	0.945 ±0.276	1.181 ^{+1.063} _{-0.709}	0.984 ±0.256	1.102 ^{+1.024} _{-0.591}	1.102 ±0.331	
12.402	15.748	0.748 ±0.157	1.063 ^{+0.827} _{-0.827}	1.024 ±0.197	1.181 ^{+0.866} _{-0.866}	1.024 ±0.201	1.181 ^{+0.827} _{-0.827}	1.142 ±0.331	1.378 ^{+1.220} _{-0.787}	1.181 ±0.303	1.260 ^{+1.102} _{-0.709}	1.299 ±0.394	
15.748	19.685	0.945 ±0.193	1.260 ^{+0.984} _{-0.984}	1.260 ±0.244	1.378 ^{+1.024} _{-1.024}	1.260 ±0.248	1.417 ^{+0.984} _{-0.984}	1.378 ±0.394	1.575 ^{+1.378} _{-0.945}	1.417 ±0.362	1.496 ^{+1.299} _{-0.866}	1.575 ±0.469	
19.685	24.803	1.181 ±0.236	1.496 ^{+1.142} _{-1.142}	1.496 ±0.295	1.614 ^{+1.220} _{-1.220}	1.535 ±0.307	1.654 ^{+1.142} _{-1.142}	1.654 ±0.472	1.850 ^{+1.654} _{-1.102}	1.732 ±0.433	1.772 ^{+1.535} _{-0.984}	1.890 ±0.563	
24.803	31.496	1.457 ±0.291	1.850 ^{+1.378} _{-1.378}	1.850 ±0.370	1.929 ^{+1.417} _{-1.417}	1.929 ±0.386	2.047 ^{+1.378} _{-1.378}	2.047 ±0.587	2.165 ^{+1.929} _{-1.299}	2.126 ±0.531	2.165 ^{+1.772} _{-1.181}	2.283 ±0.685	
31.496	39.370	1.811 ±0.366	2.244 ^{+1.654} _{-1.654}	2.244 ±0.457	2.087 ^{+1.732} _{-1.732}	2.402 ±0.476	2.480 ^{+1.654} _{-1.654}	2.520 ±0.713	2.598 ^{+2.323} _{-1.575}	2.598 ±0.638	2.638 ^{+2.165} _{-1.417}	2.795 ±0.839	

OPEN-DIE MACHINED FORGINGS

Open-die machined forgings manufactured by SIJ Metal Ravne include rolls, shafts, mandrels, bushes, rings, and plates. All open-die machined forgings can be subjected to heat treatment (normalizing, soft annealing, hardening and tempering, quenching, etc.) and mechanically treated with turning, milling, drilling, etc.

The advantages of open-die machined forgings are shared by both customer and manufacturer:

- more precise ultrasonic analysis
- reduced possibility of surface defects
- reduced possibility of dimensional deviations
- the customer has less issues with material storage and cutoffs
- more homogeneous microstructure
- improved mechanical properties



APPLICATION AREAS:

- Mechanical engineering (rolls, shafts)
- Hot-forming rolls (for steel, aluminium, aluminium foil)
- Mining industry (shafts, gears)
- Automotive (dies, frames)
- Shipbuilding industry (shafts, stabilizers)
- Metallurgical industry (tools, mandrels, extrusion sleeves)
- Metalworking industry (sleeves, rings for cutting dies)
- Energy industry (turbine shaft housing, sealing rings, shafts)
- Oil & gas industry (tubes, connectors)
- Graphic industry (rolls for newspaper printing)

DIMENSIONAL RANGE:

ROLLS, AXLES, SHAFTS	
max. dia.	39.370"
max. length	393.70"
max. weight	44093 lbs

RINGS, DISCS	
max. external dia.	78.740"
max. weight	33069 lbs

BUSHES	
max. dia.	55.118"
max. length	86.61"
max. weight	33069 lbs



STEEL GRADES

OUR STEEL CONSUMERS ARE VARIOUS INDUSTRIES:

- Energy
- Oil & gas industry
- Automotive
- Aerospace
- Toolmaking
- Machine building
- Industrial rolls
- Industrial knives
- Medicine
- Other industries

THE POWER OF OUR BRANDS

By establishing SIJ Group brands we will achieve a uniform classification of a wide range of steels. An individual brand represents an identifiable group of steels and products, which serve a clearly defined application and at the same time reflect the superior quality of SIJ Group products. Every brand is characterised by the letters SI, middle name and three dots. The letters SI are derived from the name of the SIJ Group, thus connecting these. The three dots represent our three values. The middle brand name describes the properties of each steel group and products bearing the brand name. Brands are instantly recognisable and fully embrace SIJ Group steel products.



STAINLESS STEEL

DESIGNATION		CHEMICAL COMPOSITION (WT. %)									MICRO-STRUCTURE	STANDARD WORK STRENGTH/ HARDNESS
SIJ BRAND	W. NR.	C	Si	Mn	Cr	Mo	Ni	V	Nb	OTHER		
SINOXX 4006	1.4006	0.12	0.25	0.60	12.50	-	-	-	-	-	M	Rm: min 650 Mpa, A: min 15 %
SINOXX 4016	1.4016	0.03	0.25	0.60	17.00	-	-	-	-	-	F	Rm: min 400 Mpa, A: min 20 %
SINOXX 4021	1.4021	0.19	0.25	0.60	13.00	-	-	-	-	-	M	Rm: min 800 Mpa, A: min 11 %
SINOXX 4034	1.4034	0.47	0.25	0.60	13.00	-	-	-	-	-	M	Rm: min 850 Mpa, A: min 8 %
SINOXX 4112	1.4112	0.90	0.40	0.40	18.00	1.00	-	0.10	-	-	M	Hardened: min 55 HRC
SINOXX 4116	1.4116	0.50	0.25	0.60	14.50	0.60	-	0.15	-	-	M	Hardened: min 55 HRC
SINOXX 4125	1.4125	1.05	0.25	0.60	17.00	0.60	-	-	-	-	M	Hardened: min 58 HRC
SINOXX 4313	1.4313	0.03	0.25	0.60	13.00	0.50	4.00	-	-	N 0.03	M	Rm: min 900 Mpa, A: min 15 %
SINOXX 4462	1.4462	0.02	0.40	1.50	22.00	3.00	5.50	-	0.14	-	A+F	Rm: min 650 Mpa, A: min 25 %
SINOXX 4542	1.4542	0.04	0.25	0.60	15.20	-	4.00	-	0.30	Cu 3.50	PH	Rm: min 1310 Mpa, A: min 10 %
SINOXX 4550	1.4550	0.03	0.25	0.60	18.00	-	10.00	-	0.40	-	A	Rm: min 510 Mpa, A: min 40 %
SINOXX 4923	1.4923	0.21	0.25	0.60	12.00	1.00	0.50	0.30	-	-	M	Rm: min 900 Mpa, A: min 11 %
SINOXX 4938	1.4938	0.12	0.25	0.60	12.00	1.80	2.60	0.30	-	N 0.03	M	Rm: min 930 Mpa, A: min 14 %
SINOXX 4980	1.4980	0.05	0.25	1.20	14.50	1.20	25.00	0.20	-	Ti 2.10	PH	Rm: min 900 Mpa, A: min 15 %
SINOXX S490	-	0.05	3.00	8.00	17.00	-	8.50	-	-	-	A	Rm: min 655 Mpa, A: min 35 %
SINOXX S690	1.3964	0.03	0.50	5.00	22.00	2.25	0.20	12.25	0.20	N 0.30	A	Rm: min 690 Mpa, A: min 35 %

M - Martensite | F - Ferrite | A - Austenite | PH - Precipitation hardened

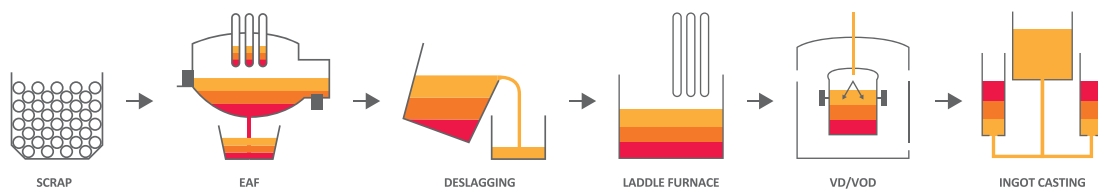
APPLICATION:

- **Steel for fittings:** SINOXX 4006, SINOXX 4313, SINOXX 4462, SINOXX S490, SINOXX S690, SINOXX 4980
- **Steel for turbine blades:** SINOXX 4923, SINOXX 4938
- **Steel for surgical instruments:** SINOXX 4021, SINOXX 4034, SINOXX 4112, SINOXX 4116, SINOXX 4125
- **Steel for pressure vessels:** SINOXX 4923, SINOXX 4938

- **Steel for pump shafts:** SINOXX 4542, SINOXX 4980, SINOXX S690
- **Bearing steel:** SINOXX 4034, SINOXX 4112, SINOXX 4125
- **Chemical industry:** SINOXX 4021, SINOXX 4462, SINOXX 4550, SINOXX 4938, SINOXX S690
- **Food-processing industry:** SINOXX 4006, SINOXX 4016, SINOXX 4021, SINOXX 4112, SINOXX 4550

SPECIAL STAINLESS STEEL FOR SPECIAL PURPOSES: VACUUM OXYGEN DECARBURIZATION (VOD) STEEL

VOD (Vacuum Oxygen Decarburization) is a process for refinement of stainless steel through reduction of carbon content under vacuum. The process is based on oxidation of carbon which has to be reduced below 0.1 wt. % for better corrosion resistance of stainless steels.



Molten steel is transferred from the electric arc furnace to a separate vessel where it is heated with electric current and mixed with inert argon gas. Oxygen is blown on the top of steel in the vacuum chamber. Carbon is oxidized and carbon monoxide/dioxide is formed. Gases as nitrogen, hydrogen, oxygen and carbon monoxide/dioxide are drained out of the vessel with vacuum pumps. Thermodynamical laws under vacuum allow that chromium is not oxidized or very small amounts go into slag as Cr_2O_3 . This makes the VOD process a very good choice for the production of high-chromium steels with low carbon content.

MAIN APPLICATIONS

- aircraft applications,
- applications at high temperatures and in oxidizing environments (e.g. power generation like turbine blades),
- applications where higher resistance to pitting and intergranular corrosion is required,
- chemical industry,
- petrochemical industry,
- glass processing tools,
- energy industry,
- welding applications.

BENEFITS

Find out the benefits of special steels made according to VOD process from a classically cast ingot in comparison with continuous casting:

- possibility for the production of larger forging blocks, also from a 40 ton ingot,
- higher rate of hot forming, with better mechanical properties, finer grains and a homogeneous microstructure throughout the whole product section,
- option to use EAF+VOD+ESR material with an even better micropurity, lower micro segregations and better mechanical properties,
- products made from these steels have a longer life period under extreme operation conditions of final product, in particular due to a higher stability of material. You will enjoy lower cost of material and, which is the most important: satisfied customers!

HOT WORK TOOL STEEL

DESIGNATION		CHEMICAL COMPOSITION (WT. %)								HARDENED STEEL (HRC)	WORK HARDNESS (HRC)
SIJ BRAND	W. NR.	C	Si	Mn	Cr	Mo	V	Ni	OTHER		
SITHERM 2343*	1.2343	0.37	1.00	0.40	5.00	1.30	0.40	-	-	50 - 56	43 - 48
SITHERM 2344*	1.2344	0.39	1.05	0.40	5.15	1.35	1.00	-	-	52 - 56	43 - 50
SITHERM 2345*	1.2345	0.51	0.95	0.30	5.00	1.35	0.90	-	-	55 - 57	45 - 52
SITHERM 2365*	1.2365	0.32	0.25	0.30	2.95	2.75	0.55	-	-	52 - 56	40 - 48
SITHERM 2367*	1.2367	0.38	0.40	0.40	5.00	2.95	0.50	-	-	53 - 57	44 - 50
SITHERM 2885*	1.2885	0.32	0.25	0.30	2.80	2.80	0.50	-	Co: 2.80	52 - 54	44 - 50
SITHERM S140R	-	0.36	Max. 0.30	0.20	Max. 0.20	3.20	-	2.10	W: 1.20 Co: +	50	44 - 48
SITHERM S350R	-	0.36	0.20	0.30	5.00	1.35	0.45	-	-	50 - 54	43 - 48
SITHERM S353R	-	0.38	0.25	0.40	5.00	2.40	0.60	-	-	53 - 57	44 - 50
SITHERM S354R**	-	0.38	0.20	0.50	5.00	1.80	0.70	-	-	52 - 56	44 - 50
SITHERM S360R	-	0.52	0.25	0.30	4.80	3.00	0.60	0.60	+	min. 60	48 - 56
SITHERM S361R	-	0.37	0.25	0.40	4.90	1.80	0.60	1.60	+	52 - 56	44 - 50

* also in ESR

** also available in ESR and classic form

APPLICATION:

Pressure die casting tools, die forging tools, extrusion dies

- **Die forging tools:** SITHERM 2343, SITHERM 2344, SITHERM 2345, SITHERM 2365, SITHERM 2367, SITHERM S350R, SITHERM S353R, SITHERM S360R, SITHERM S361R

- **Pressure die casting tools for Al and Al-Mg-alloys:** SITHERM 2343, SITHERM 2344, SITHERM 2345***, SITHERM 2367, SITHERM S350R, SITHERM S360R***, SITHERM S361R, SITHERM S140R

- **Pressure die casting tools for Cu and Cu-alloys:** SITHERM 2344, SITHERM 2365, SITHERM 2367, SITHERM 2885, SITHERM S353R, SITHERM S354R, SITHERM S360R***, SITHERM S361R, SITHERM S140R

- **Hot Cutting:** SITHERM 2345, SITHERM S360R

- **Extrusion dies for Al and Al-alloys:** SITHERM 2343, SITHERM 2344, SITHERM 2367, SITHERM S350R, SITHERM S353R, SITHERM S360R***, SITHERM S361R

- **Extrusion dies for Zn and Pb-alloys:** SITHERM 2343, SITHERM 2344, SITHERM 2365, SITHERM 2367, SITHERM S350R, SITHERM S353R, SITHERM S360R***, SITHERM S361R, SITHERM S140R

- **Extrusion dies for Cu and Cu-alloys:** SITHERM 2367, SITHERM 2885, SITHERM S360R***, SITHERM S361R

- **Hot stamping:** SITHERM 2367, SITHERM S360R, SITHERM S140R

*** inserts
R - Remelted

COLD WORK TOOL STEEL

DESIGNATION		CHEMICAL COMPOSITION (WT. %)									HARDNESS AFTER HARD. (HRC) MIN.	WORK HARDNESS (HRC)
SIJ BRAND	AISI	C	Si	Mn	Cr	Mo	Ni	V	W	OTHER		
SIHARD 2080	D3	2.05	0.25	0.30	11.50	-	-	-	-	-	64	57 - 62
SIHARD 2357	S7	0.50	0.60	0.60	3.30	1.50	-	0.10	-	-	60	55 - 60
SIHARD 2361	440B	0.90	0.50	0.50	18.00	1.10	-	0.10	-	-	57	50 - 55
SIHARD 2363	A2	1.00	0.30	0.55	5.20	1.05	-	0.20	-	-	63	57 - 61
SIHARD 2379	D2	1.55	0.25	0.30	11.50	0.70	-	1.00	-	-	64	57 - 61
SIHARD 2510	O1	0.95	0.25	1.10	0.60	-	-	0.10	0.60	-	64	57 - 62
SIHARD 2767	6F7	0.45	0.25	0.30	1.35	0.25	4.00	-	-	-	56	52 - 55
SIHARD 2842	O2	0.90	0.25	2.00	0.35	-	-	0.10	-	-	64	57 - 62
SIHARD K560	A8 Mod.	0.50	1.15	0.35	7.30	1.40	-	0.55	-	-	57	55 - 57
SIHARD S460	-	1.00	1.10	0.30	8.00	2.30	-	0.30	-	-	63	57 - 61
SIHARD S470	-	0.90	0.25	0.40	8.00	1.50	-	2.10	-	-	62	57 - 61
SIHARD S471	-	1.10	1.00	0.35	7.90	1.50	-	2.10	1.20	-	64	57 - 62
SIHARD S671	-	1.25	0.20	0.30	10.00	1.00	-	Max. 1.00	-	Ti: +	62	57 - 61

APPLICATION:

Cutting tools, knives, punching dies, bushes, piercing mandrels, reamers, rolls, stamping dies, roller bearings, die plates, surgical instruments.

- **Cutting-off tools:** SIHARD 2080, SIHARD 2361, SIHARD 2363, SIHARD 2379, SIHARD 2842, SIHARD K560, SIHARD S471 AND SIHARD S671
- **Extrusion dies:** SIHARD 2080, SIHARD 2379, SIHARD S471, SIHARD S671
- **Permanent impact loading tools:** SIHARD 2357, SIHARD 2510

PLASTIC MOLD STEEL

DESIGNATION		CHEMICAL COMPOSITION (WT. %)											WORK HARDNESS
SIJ BRAND	W. NR.	C	Si	Mn	Cr	Mo	Ni	V	S	AL	Cu	P	
SIMOLD 2311	1.2311	0.40	0.40	1.50	1.90	0.20	-	-	-	-	-	-	255 - 310 HBW
SIMOLD 2312	1.2312	0.40	0.40	1.50	1.90	0.20	-	-	0.07	-	-	-	255 - 310 HBW
SIMOLD 2738*	1.2738	0.40	0.30	1.40	1.90	0.20	1.00	-	-	-	-	-	280 - 325 HBW
SIMOLD S131	1.2738 HH	0.28	max. 0.3	1.40	1.50	0.50	1.00	0.15	-	-	-	-	320 - 360 HBW
SIMOLD S133	-	0.28	max. 0.4	1.40	1.40	0.50	1.00	0.22	-	-	-	-	350 - 390 HBW
SIMOLD S150R	-	0.13	0.31	1.50	0.25	0.30	2.85	-	-	0.95	1.00	-	40 - 42 HRC
SIMOLD 2083	1.2083	0.35	0.40	0.25	13.00	0.20	0.20	-	-	-	-	-	38 - 43 HRC
SIMOLD 2085	1.2085	0.30	0.35	0.80	15.00	-	-	-	0.07	-	-	-	50 - 54 HRC
SIMOLD 2316	1.2316	0.39	max. 1.00	max. 1.00	16.50	max. 1.05	max. 1.00	-	-	-	-	-	28 - 36 HRC**
Other plastic mold steel													
SINOXX 4034*	1.4034	0.46	0.50	0.50	13.00	-	-	-	-	-	-	-	55 - 57 HRC
SINOXX 4125*	1.4125	1.05	0.50	0.50	17.00	0.50	-	-	-	-	-	-	min. 58 HRC
SITHERM 2343*	1.2343	0.38	1.00	0.40	5.10	1.25	-	0.40	-	-	-	-	43 - 48 HRC
SIQUAL 8550	1.8550	0.34	0.25	0.55	1.65	0.20	1.00	-	-	1.00	-	-	25 - 32 HRC
SIHARD 2379	1.2379	1.55	0.25	0.30	11.50	0.70	-	1.00	-	-	-	-	62 - 64 HRC
SIHARD 2767	1.2767	0.45	0.25	0.30	1.35	0.25	4.00	-	-	-	-	-	56 HRC

* also in ESR

** depending on size

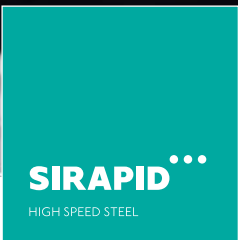
APPLICATION:

Compression molding, injection molding, extrusion (inserts, dies, cores, frame)

- **Case-hardening and nitriding steel:** SIQUAL 7147, SIQUAL 8550
- **Through-hardening steel:** SITHERM 2343, SIHARD 2767, SIHARD 2379
- **Maraging steel:** SIMOLD S150R

- **Hardening & tempering steel:** SIMOLD 2311, SIMOLD 2312, SIMOLD 2738, SIMOLD S131 AND SIMOLD S133
- **Corrosion-resistant steel:** SIMOLD 2083, SIMOLD 2085, SIMOLD 2316, SINOXX 4034 AND SINOXX 4125

R – Remelted



HIGH-SPEED STEEL

DESIGNATION		CHEMICAL COMPOSITION (WT. %)						ACHIEVABLE HARDNESS (HRC) MIN.
SIJ BRAND	AISI	C	Cr	Mo	V	W	Co	
SIRAPID 3343	M2	0.90	4.10	5.00	1.90	6.30	-	64
SIRAPID 3346	M1	0.82	3.90	8.50	1.20	1.70	-	63
SIRAPID 3344	M3	1.20	4.10	5.00	2.90	6.30	-	64
SIRAPID 3351	M4	1.32	4.10	4.60	3.90	5.60	-	64
SIRAPID 3355	T1	0.78	4.10	-	1.10	17.90	-	63
SIRAPID 3302	T15	1.27	4.10	0.90	3.70	12.00	-	65

APPLICATION:

Twist drills, tap drills, cutting tools, milling cutters, reamers, saw blades and segments, turning machine tools, planing machine tools, broaches, broach needles, wear-resistant inserts for tools, Sendzimir rolls

- **Tools for machining of steel and Fe-alloys:** SIRAPID 3343, SIRAPID 3355, SIRAPID 3346, SIRAPID 3344, SIRAPID 3302, SIRAPID 3351
- **Woodworking tools:** SIRAPID 3343, SIRAPID 3355, SIRAPID 3344
- **Tools for machining of non-ferrous metals:** SIRAPID 3343, SIRAPID 3355, SIRAPID 3346, SIRAPID 3344, SIRAPID 3302, SIRAPID 3351
- **Tools for treatment of plastics:** SIRAPID 3343, SIRAPID 3344
- **Sendzimir rolls:** SIRAPID 3343, SIRAPID 3346, SIRAPID 3344

RESEARCH AND DEVELOPMENT

THE STEELMAKING TRADITION WE TAKE PRIDE IN, CAN BE PRESERVED AND UPGRADED ONLY THROUGH DYNAMIC DEVELOPMENT.

- Our R&D Department performs metallurgical research, develops new products, and **implements and optimizes new technologies**.
- We employ a team of **highly qualified and experienced professionals** who are constantly improving and learning, as we wish to provide added value on a long-term basis for our customers.
- For research, we have **modern research equipment** including optical microscopes, a portable digital microscope, a scanning electron microscope with an EDS analyser, an X-ray diffractometer and a dilatometer. In our laboratories we can determine thermal conductivity of steels and test polishing capabilities of tool steels. In addition, we have a well equipped mechanical and chemical laboratory as well as laboratory heat-treatment furnaces.
- Our R&D team collaborates closely also with external institutions
- Each year, we develop over **100 new products** and manufacture **6–10 new grades of steel**.
- Newly developed products represent about 7% of our annual turnover.



QUALITY ASSURANCE



OUR PRIMARY GOAL IS TO BE A SUCCESSFUL COMPANY WITH BOLD GOALS THAT LEAD US TO CONTINUOUS AND SUSTAINABLE IMPROVEMENT OF MANAGEMENT SYSTEMS IN QUALITY, ENVIRONMENT, HEALTH AND SAFETY AT WORK, AND RATIONAL ENERGY USE.

Our company introduced and upholds the Quality Management System for the areas of design, development, production and sale of forged and rolled products from special steels and alloys using different metallurgical methods, heat treatment and machining procedures in compliance with **EN 9100** standard.

The standard is technically equivalent to the **AS 9100D** and **JISQ 9100** standards for aviation, space and defence organizations, including all requirements for the Quality Management System according to **ISO 9001** standard.

The key objective of our long-term vision is to work according to sustainable development and circular economy principles. We develop products and processes with the goal of preventing pollution and reducing environmental impacts, which can be proven with the **ISO 14001** certificate we have acquired.

SIJ Metal Ravne introduced a health and safety at work management system in accordance with **ISO 45001** requirements. Various measures reduce risk and provide safe, healthy, and creative work conditions, which is constantly being discussed with our employees.

In June 2018 our laboratory has successfully passed an assessment according to the requirements of the **ISO/IEC 17025** standard and obtained an accreditation document as a testing laboratory. This accreditation signifies the highest level of quality and guarantees the independence, impartiality, and the international comparability of test results.

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SIX **GOOD REASONS** WHY SIJ METAL RAVNE IS THE RIGHT PARTNER IN BUSINESS:

- WE SEARCH FOR NEW **SOLUTIONS** WITH OUR CUSTOMERS
 - HIGH QUALITY OF OUR PRODUCTS AND SERVICES
 - **EXCELLENT SKILLS OF OUR EMPLOYEES** WHICH PASS FROM ONE GENERATION TO ANOTHER
 - **NICHE AND FLEXIBLE PRODUCTION** OF THE MOST DEMANDING PRODUCTS WITH HIGH ADDED VALUE
 - ADVANTAGE OF **SYNERGY EFFECTS** WITHIN SIJ GROUP WHICH IS THE LARGEST VERTICALLY INTEGRATED METALLURGICAL GROUP IN SLOVENIA
 - RESPONSIBILITY FOR **SUSTAINABLE** FUTURE
- 



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SLOVENIA

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