sij | ravne steel

PLASTIC MOULD STEEL

RS 100

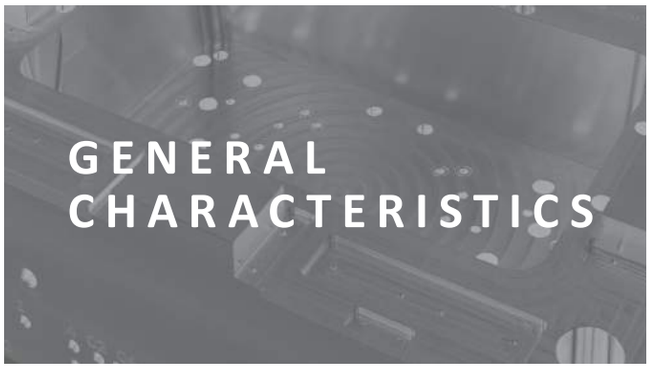
→ PLASTIC MOULD STEEL

Family of RS plastic mould steel

RS grade	W.Nr.	DIN	AISI
RS 100	1.2312	40CrMnMoS8-6	~P20
RS 101	1.2311	40CrMnMo7	~P20
RS 103	1.2738	40CrMnNiMo8-6-1	
RS 105	1.2738 mod. HH		
RS 110 RAVNEX	1.2738 mod. HH ESR		
RS 118	1.2085	X33CrS16	
RS 120 RAVNEX			
RS 130	1.2083 ESR	X42Cr13	420
RS 131	1.2083	X42Cr13	420
RS 140	1.2316 ESR	X36CrMo17	
RS 141	1.2316	X36CrMo17	

RS 100

CONTENTS



GENERAL CHARACTERISTICS

NOTES

RS 100 is a high quality steel for moulds for plastics produced in SIJ group.
Tool steel **RS 100** is known for its:

- Good wear resistance
- Moderate polishability
- Good Machinability
- Delivered in pre-hardened condition
- Homogeneity
- Nitrability
- Tempering resistance
- Dimensional stability

RS CHEMICAL COMPOSITION (%)

Controlled chemical composition with minimal concentration of detrimental elements and controlled cleanliness.

RS GRADE	AISI	W.Nr.	C	Mn	S	Cr	Mo
RS 100	~P20+S	1.2312	0.40	1.50	0.075	1.90	0.20

Chemical element content is in wt %

RS APPLICATION

RS 100 is used for moulds for plastic processing and mould frames. Its application can be found in pressure die casting (clamping and holder plates), for prototypes, extrusion dies for thermoplastics. It is known for its good machinability.

RS 100 is usually used for medium sized moulds where moderate polishing is required (plastics and rubber moulds).

NOTES

GENERAL CHARACTERISTICS

MICROSTRUCTURE IN DELIVERED CONDITION

RS 100 is supplied in pre-hardened condition at 280-325 HBW.

RS 100 is inspected in hardened and tempered condition. Microstructure is composed of fully homogenous tempered martensite and bainite with uniformly distributed sulfides for improved machinability.

500 ×

NOTES

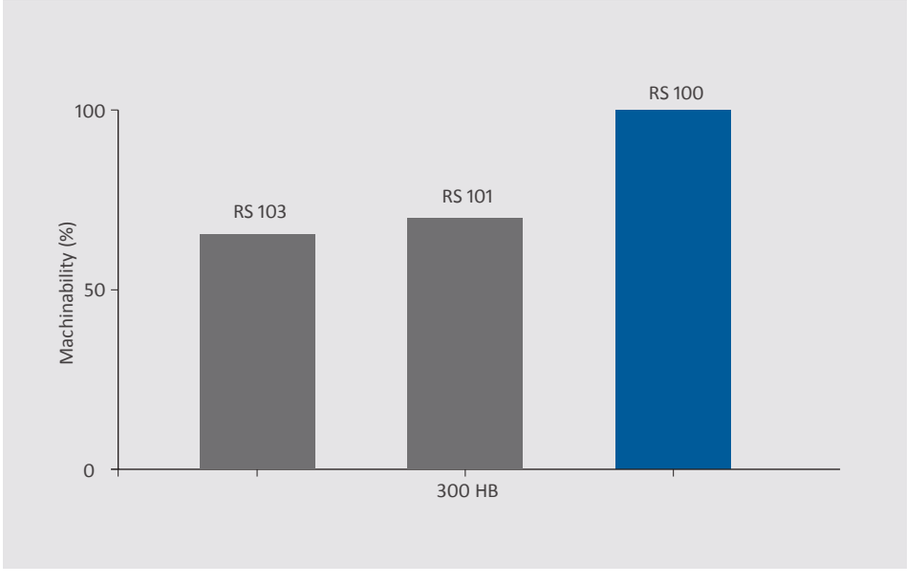
GENERAL CHARACTERISTICS

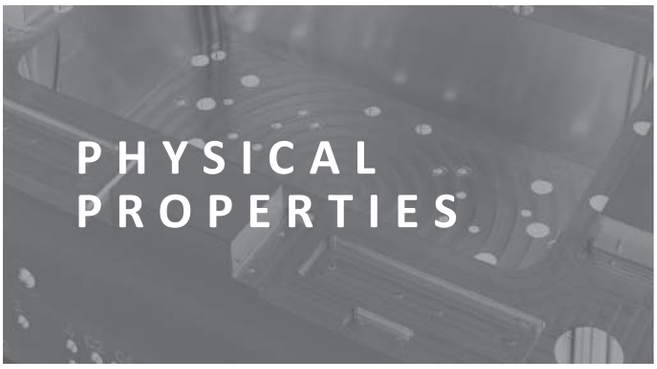
→ TOUGHNESS

Smaller to medium size moulds are recommended for particular grade.
Larger size moulds demand higher toughness.

→ QUALITATIVE COMPARISON

Chart shows machinability of **RS 100** compared to RS 101 and RS 103. Properties are measured at 25 °C. Milling and drilling speed is higher compared to RS 101. Tool life is increased due to lower tool wear.





PHYSICAL PROPERTIES

NOTES

→ PHYSICAL PROPERTIES (TEMPERATURE DEPENDENT)

DENSITY (g/cm³)

7.83 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

THERMAL CONDUCTIVITY (W/(m.K))

33.3 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

ELECTRIC RESISTIVITY (Ohm.mm²/m)

0.19 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

SPECIFIC HEAT CAPACITY (J/(g.K))

0.46 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

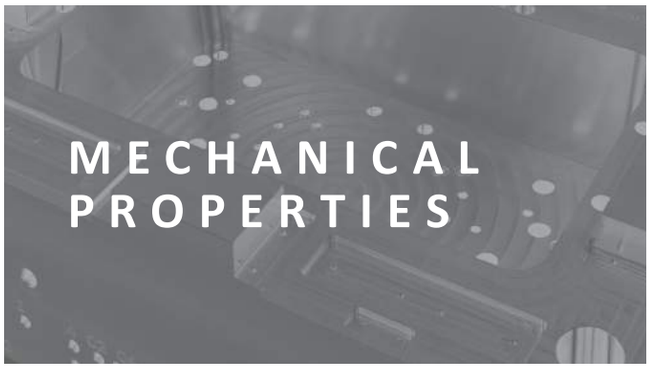
MODULUS OF ELASTICITY (10³xN/mm²)

210 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

COEFFICIENT OF LINEAR THERMAL EXPANSION (10^{-6} °C $^{-1}$, 20 °C)*

11.70 (100 °C)	13.10 (200 °C)	13.50 (300 °C)	14.00 (400 °C)	14.40 (500 °C)

CTE is the mean coefficient of thermal expansion with reference temperature of 20 °C.

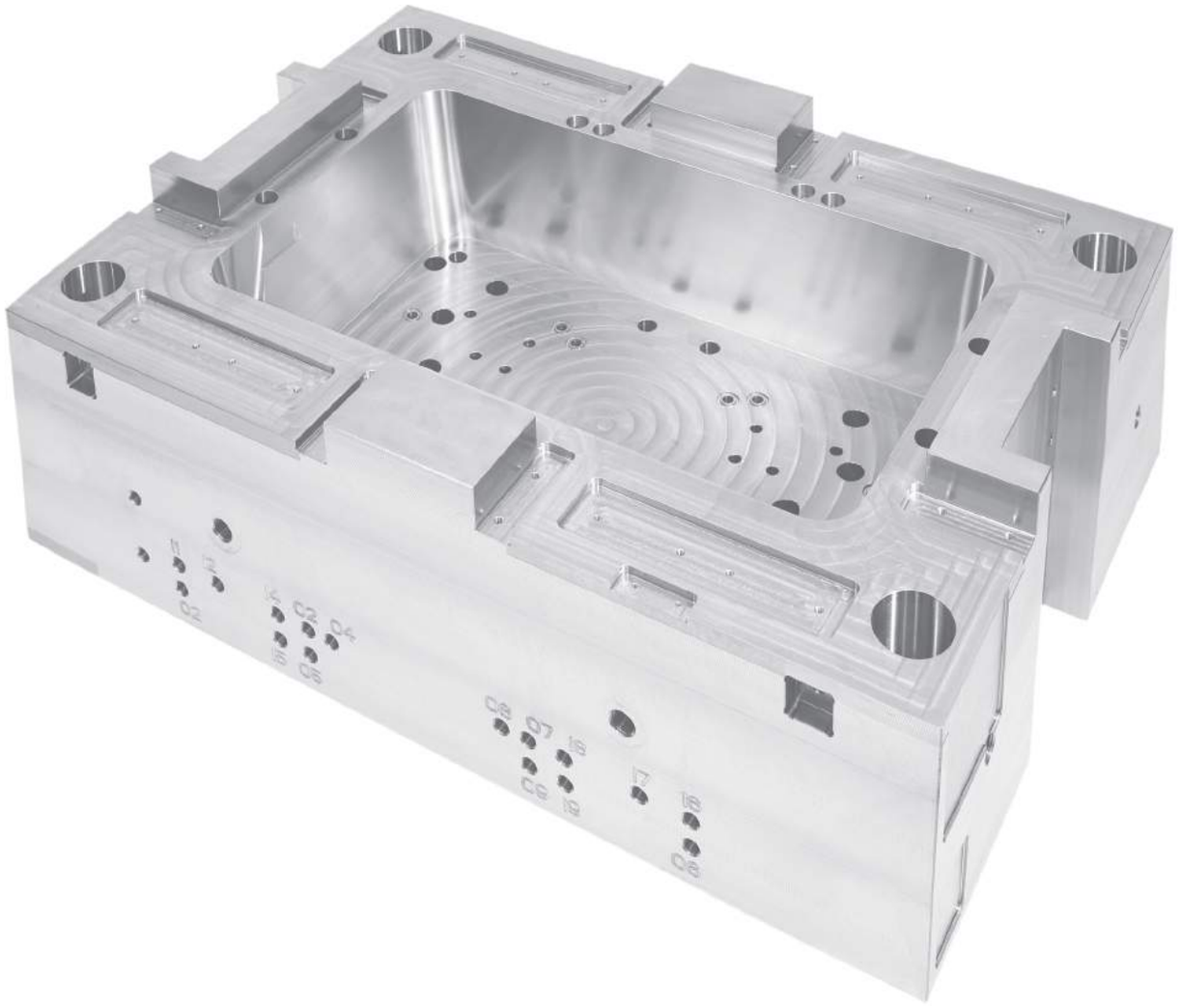


MECHANICAL PROPERTIES

NOTES

→ COMPRESSIVE YIELD STRENGTH

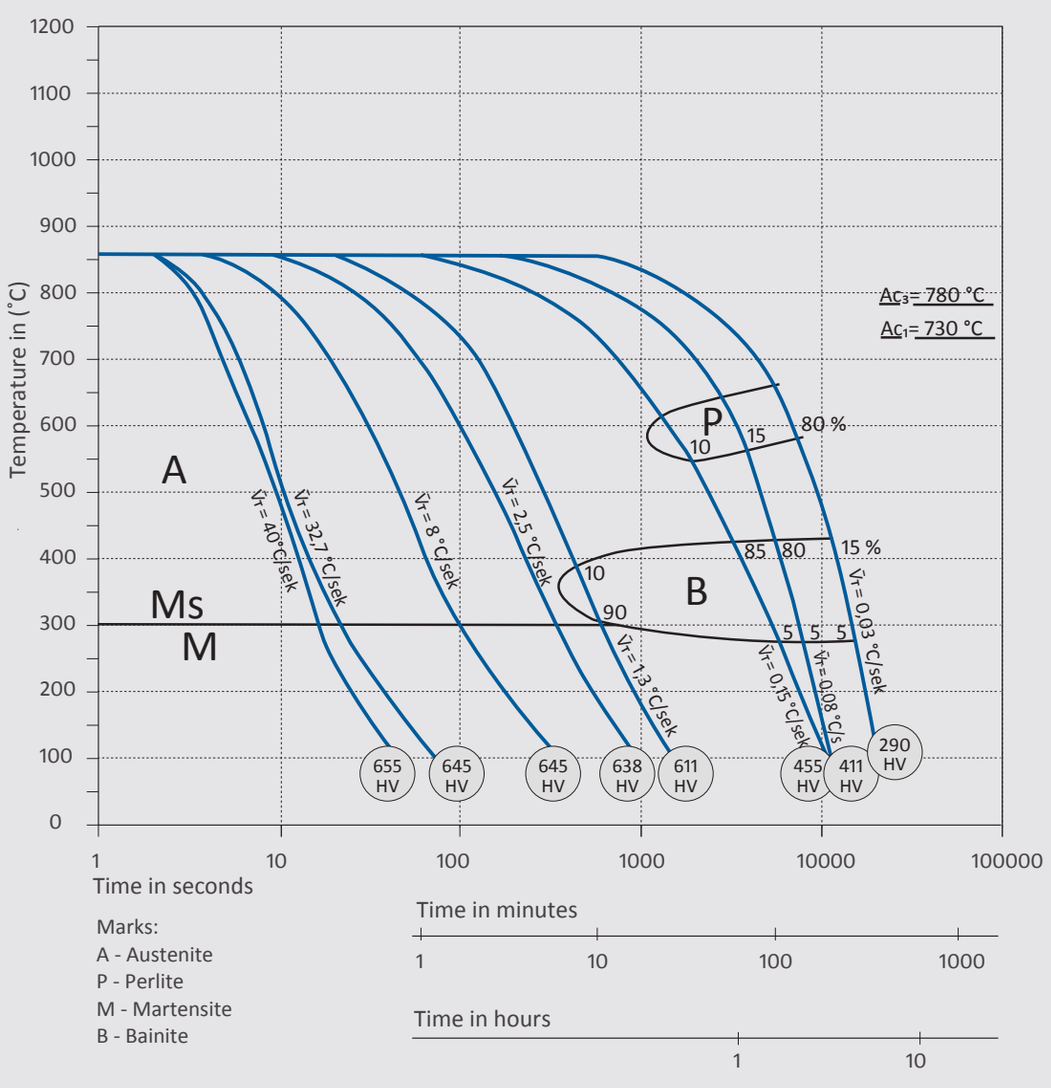
High compressive yield strength, $R_{c0.2}$, of tool steel is needed to avoid or to minimize plastic deformation. Compressive yield strength in as-delivered condition is between 900 - 1100 N/mm².



CONTINIOUS COOLING CURVES-CCT

NOTES

Austenitising temperature: 860 °C, holding time: 15 min



TIP 1 → **Pre-hardened tool steel is machined without additional heat treatment, except where additional stress reliving is necessary.**

HEAT TREATMENT

NOTES

Recommendations.

→ ANNEALING

HEATING	ANNEALING TEMPERATURE	COOLING
50 °C/h	710 - 740 °C	10 - 20 °C/h
Protect against oxidation, scaling and decarburisation.	2 hours.	Slow in the furnace. From 600 °C cooling in air is possible.

→ STRESS RELIEVING

HEATING	STRESS RELIEVING TEMPERATURE	COOLING
100 °C/h	550 °C	20 °C/h
Protect against oxidation and decarburisation.	2 hours.	Slow and uniformly in the furnace to prevent formation of additional residual stresses. Cooling in air is possible.

→ HARDENING

Hardness after hardening is 51 HRC

HEATING	AUSTENITISING	COOLING
25 - 600 °C, 150-220 °C/h 600 - 830 °C, ≤150 °C/h	830 - 880 °C	See CCT diagram
Hold in furnace at T = 600 °C until $T_{SURFACE}$-T_{CORE} ≤ 15 °C.	$T_{SURFACE}$ is measured at 15mm underneath surface, maximum soak time is 30 min.	

TIP 2 → **If flame or induction hardening is used in pre-hardened condition slow cooling is necessary with immediate tempering.**

NOTES

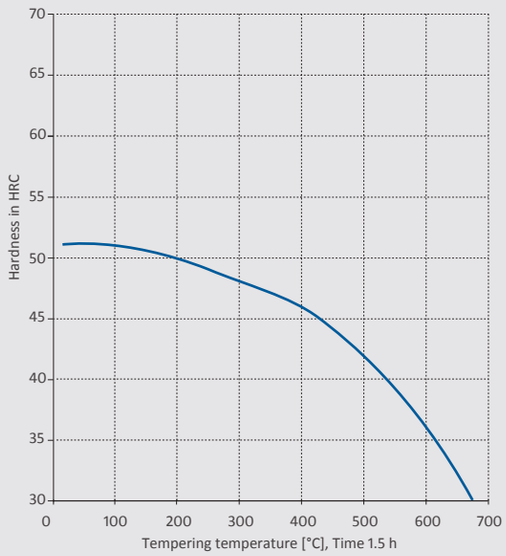
HEAT TREATMENT

→ TEMPERING

Tempering must start immediately after completion of quenching (when part reaches 90-70 °C).
Two tempering treatments are recommended. First tempering destabilizes retained austenite.
Second tempering tempers newly formed microstructure constituents.

HEATING	TEMPERING TEMPERATURE	COOLING
150 °C/h - 250 °C/h	Min.180 °C	Cool in air or in the furnace to room temperature between tempering cycles.
Protect against oxidation and decarburisation.	1 hour per 25mm wall thickness based on the furnace temperature. Minimum 2 hours.	

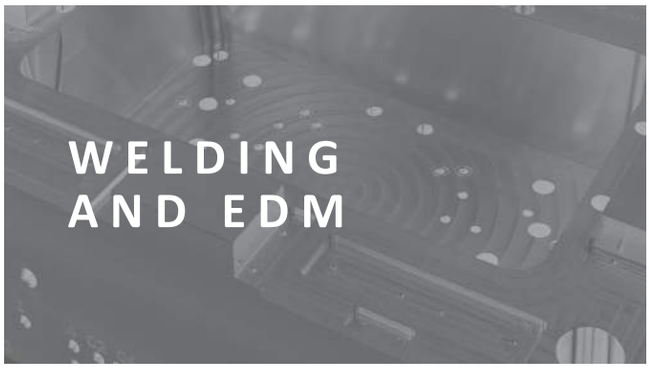
Tempering diagram



TIP 3 → **If tool steel must be re-hardened, annealing should be done prior to hardening.**

→ DIMENSIONAL CHANGES DURING HARDENING AND TEMPERING

It is recommended to leave machining allowance before hardening of minimum 0.2 % of dimension, equal in all three directions.



WELDING AND EDM

NOTES

WELDING

RS 100 is a readily weldable alloy by TIG or MMA welding processes in hardened or soft-annealed condition. Filler metal should be of the same or similar composition.

Heat treatment after welding is recommended. Annealing should be performed after welding of soft annealed parts, whereas tempering at temperature of about 50°C below tempering temperature should be performed after welding of hardened and tempered parts. Laser welding is recommended for repair of smaller cracks and edges.

PREHEATING TEMPERATURE	MAXIMUM INTERPASS TEMPERATURE	POST WELD COOLING
~250 °C	~300 °C	Approximately 30°C/h to not less than 70°C, then tempering.

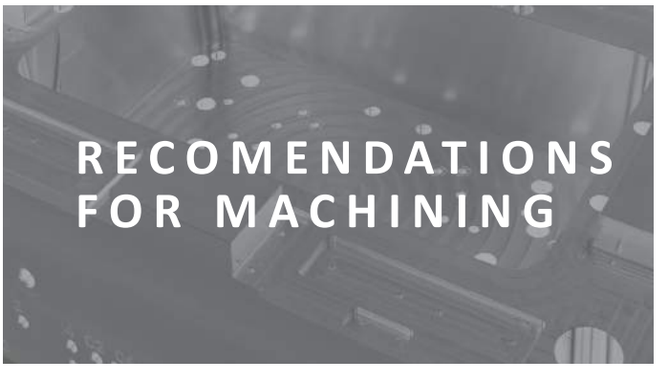
WELDING METHOD	FILLER MATERIAL	HARDNESS AFTER WELDING
TIG, MMA	P20-Type	~ 320 HB

* Risk of cracking because of sulphur addition.

ELECTRICAL DISCHARGE MACHINING

Electrical discharge machining (EDM) leaves a brittle surface layer due to melting and resolidification of surface material.

It is recommended to: (1) remove the resolidified layer by polishing, grinding or other mechanical methods, and (2) temper the work-piece at temperature of about 50 °C below the previous tempering temperature. Execution of tempering of re-hardened and yet untempered layer underneath the surface is critical.



RECOMENDATIONS FOR MACHINING

NOTES

The information below is provided solely as a general machining guideline.
It refers to material in tempered condition.

DRILLING

INSERT	DRILL DIAMETER (mm)	CUTTING SPEED (m/min)	FEED (mm/rev)
HSS	5 - 20	20	0.05 - 0.35
Coated HSS	5 - 20	30	0.05 - 0.35

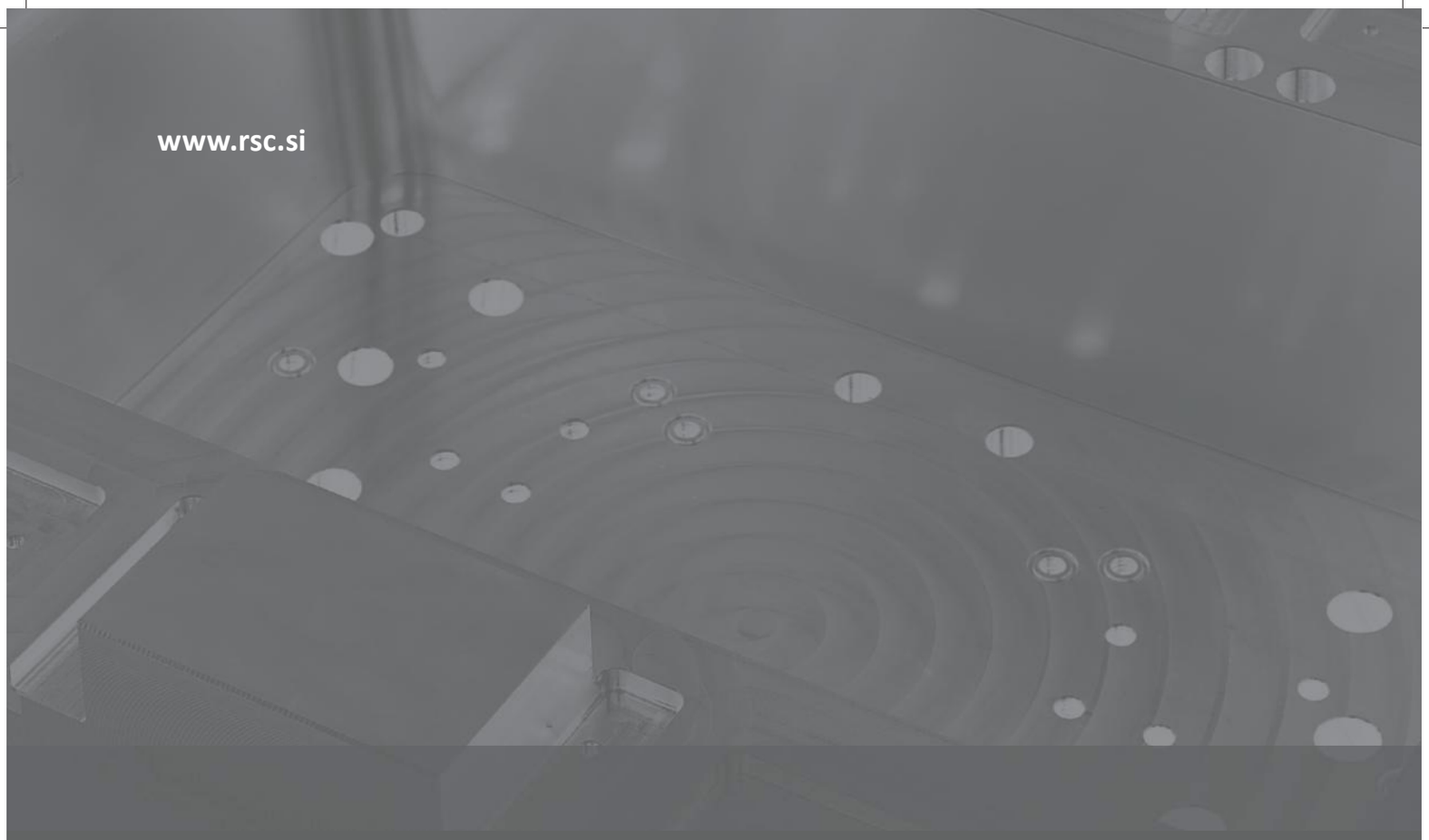
FACE MILLING

INSERT	CUTTING SPEED (m/min)	FEED (mm/tooth)	DEPTH OF CUT (mm)
P20 c. (rough milling)	90 - 150	0.2 - 0.4	2.0 - 4.0
P20 c. (fine milling)	160 - 190	0.1 - 0.2	- 2.0

TURNING

INSERT	CUTTING SPEED (m/min)	FEED (mm/rev)	DEPTH OF CUT (mm)
P20 c. (rough turning)	150 - 190	0.20 - 0.4	2.0 - 4.0
P20 c. (fine turning)	200 - 240	0.05 - 0.2	- 2.0
HSS (fine turning)	20	0.05 - 0.3	- 2.0

* C - Coated carbide



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