sij | ravne steel

COLD WORK TOOL STEEL

RAVNEX

RS 220

Family of RS cold work tool steel

RS grade	W.Nr.	DIN	AISI
RS 200	1.2379	X155CrVMo12-1	D2
RS 201	1.2080	X210Cr12	~D3
RS 202	1.2436	X210CrW12	~D6
RS 203	1.2363	X100CrMoV5-1	A2
RS 210 RAVNEX			
RS 211	1.2767	X45NiCrMo4	
RS 212	1.2510	100MnCrW4	O1
RS 213	1.2550	60WCrV7	~S1
RS 214	1.2842	90MnCrV8	~O2
RS 216	1.2746	45NiCrMoV16-6	
RS 217	1.2357	50CrMoV13-14	S7
RS 218	1.2358		
RS 220 RAVNEX			
RS 222	1.2210	115CrV3	L2
RS 223	1.4112	X90CrMoV18	440B

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GENERAL CHARACTERISTICS

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RS 220 RAVNEX is a premium, 8 % Cr cold work tool steel produced in METAL RAVNE. **RS 220 RAVNEX** is produced by conventional or ESR process. Tool steel **RS 220 RAVNEX** is known for its:

- **High abrasive wear resistance**
- **High adhesive wear resistance**
- **High toughness**
- **High compressive strength**
- **Deep hardenability**
- **Resistance to tempering**
- **Suitable for EDM**
- **Nitrability**

CHEMICAL COMPOSITION

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

RS GRADE	AISI	W.Nr.	C	Si	Mn	Cr	Mo	V
RS 220 RAVNEX	/	/	1.00	1.10	0.30	8.00	2.30	0.30

Chemical element content is in wt %

APPLICATION

RS 220 RAVNEX is used as high performance tool steel mainly for cutting, and forming operations: shearing, trimming, blanking, fine-blanking, woodworking, drawing, deep drawing. It is used also for industrial rollers and measurement tools.

RS 220 RAVNEX is also recommended for moulding tools for abrasive plastics. It guarantees better tool performance than in the case of classic 12% Cr steel.
It has improved machinability and grindability.

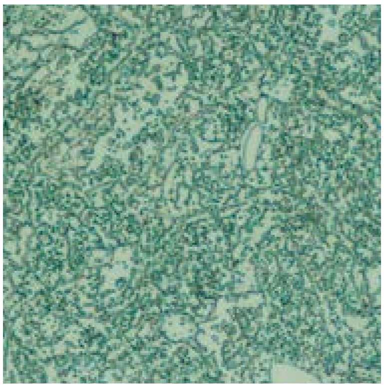
NOTES

GENERAL CHARACTERISTICS

MICROSTRUCTURE IN DELIVERED CONDITION

RS 220 RAVNEX is supplied in annealed condition, max. 250 HBW (840 N/mm²).

RS 220 RAVNEX is inspected in soft annealed condition. Uniform distribution of small and hard carbides inside ferritic matrix leads to development of enhanced and tough steel after quenching and tempering. Such microstructure is suitable for adhesive and abrasive wear mechanisms in various tooling applications. Uniform distribution and shape of carbides gives a substrate suitable for additional surface treatment like nitriding or PVD.
RS 220 RAVNEX is delivered in both conventional and ESR quality.

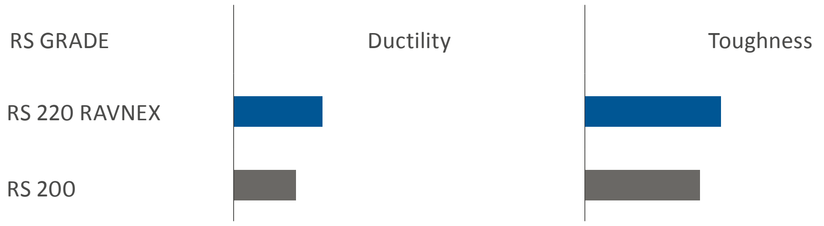


500 ×

GENERAL CHARACTERISTICS

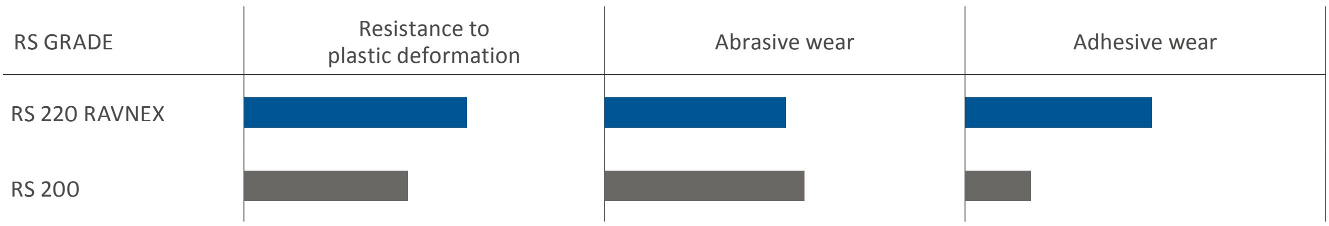
→ TOUGHNESS

High steel toughness is important to prevent cracking of the tool. Toughness (resistance to cracking) and ductility (resistance to chipping) is better than in classical RS 200.



→ QUALITATIVE COMPARISON

RS 220 RAVNEX is a premium tool steel with high adhesive wear resistance and toughness. Chart shows high adhesive wear resistance and resistance to plastic deformation at ambient temperature compared to RS 200.



PHYSICAL PROPERTIES

NOTES

PHYSICAL PROPERTIES

DENSITY (g/cm^3)

7.73 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

THERMAL CONDUCTIVITY (W/(m.K))

18 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

ELECTRIC RESISTIVITY ($Ohm.mm^2/m$)

0.64 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

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

0.49 (20 °C)	* (400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

MODULUS OF ELASTICITY ($10^3 x N/mm^2$)

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

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

11.20 (100 °C)	12.30 (200 °C)	12.90 (300 °C)	13.20 (400 °C)	13.40 (500 °C)

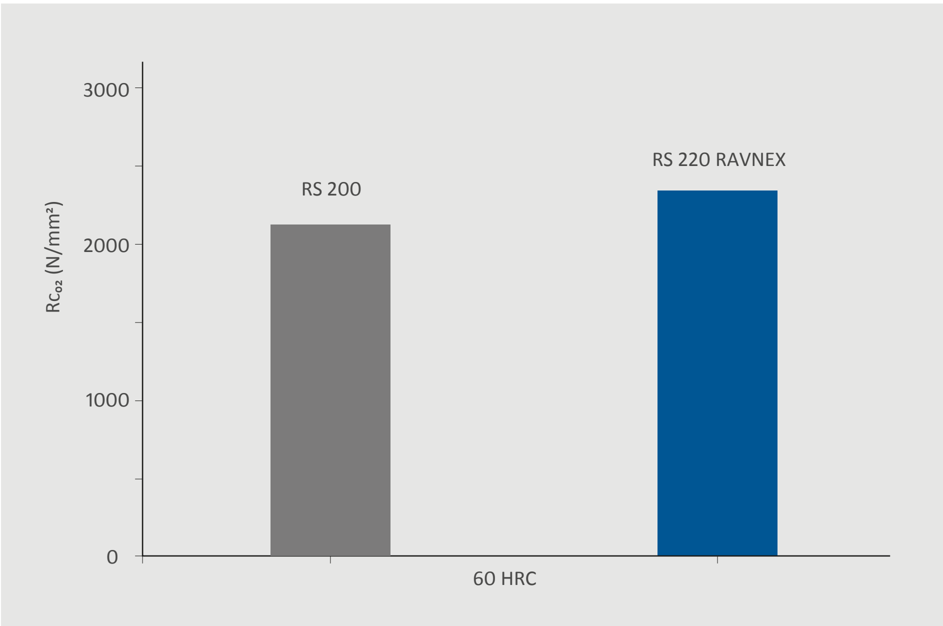
CTE is the mean coefficient of thermal expansion with reference temperature of 20 °C.

MECHANICAL PROPERTIES

NOTES

COMPRESSIVE YIELD STRENGTH

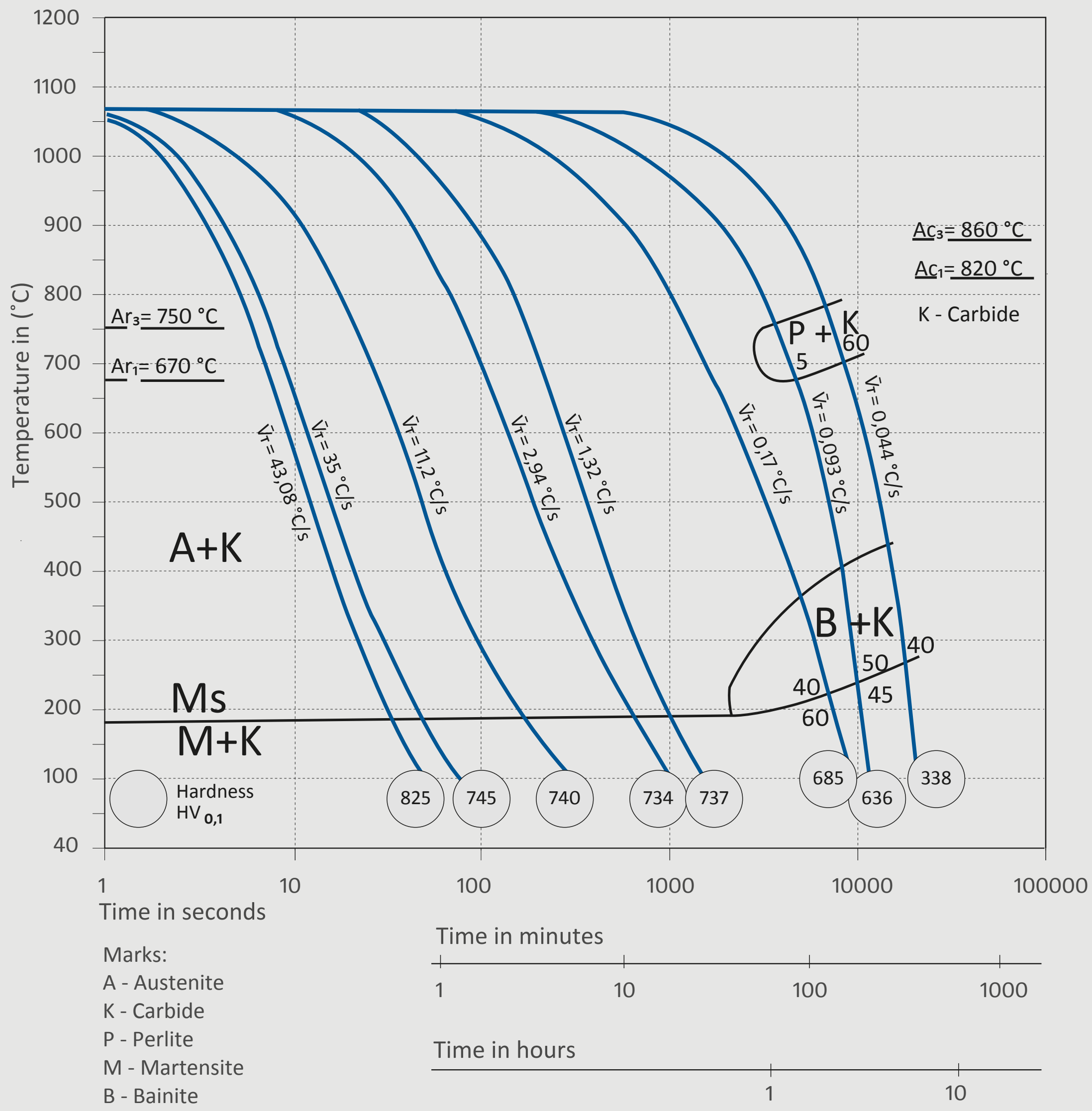
Higher compressive yield strength of cold work tool steel is needed to avoid or to minimize plastic deformation. High compressive strength is important in case subsequent surface coating is performed.



CONTINIOUS COOLING CURVES-CCT

NOTES

Austenitising temperature: 1040 - 1080 °C, soak time: 30 min.



TIP 1 → **To improve in-service life in cutting processes it is important to balance the final hardness of a tool relative to the thickness of the workpiece processed.**

HEAT TREATMENT

NOTES

Recommendations.

ANNEALING

HEATING	ANNEALING TEMP.	COOLING
50 °C/h	820 - 860 °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 TEMP.	COOLING
100 °C/h	650 °C	20 °C/h
Protect against oxidation and decarburisation.	2 hours.	Slow and uniformly in the furnace to prevent formation of additional residual stresses. From approx. 500 °C air cooling is possible.

HARDENING

Hardness after hardening is min. 60 HRC

HEATING	AUSTENITISING	COOLING
25 - 600 °C, 150-220 °C/h 600 - 850 °C, ≤150 °C/h 850 - 1040 °C, ≤150 °C/h	1040 - 1080 °C	See CCT diagram
Hold in furnace at T = 600 °C / 850°C until $T_{SURFACE}$-T_{CORE} ≤ 100 °C / 15 °C.	$T_{SURFACE}$ is measured at 15mm underneath surface, soak time is 30 min.	

TIP 2 → **To minimize the risk of surface crack nucleation and propagation during application, proper sliding conditions should be established.**

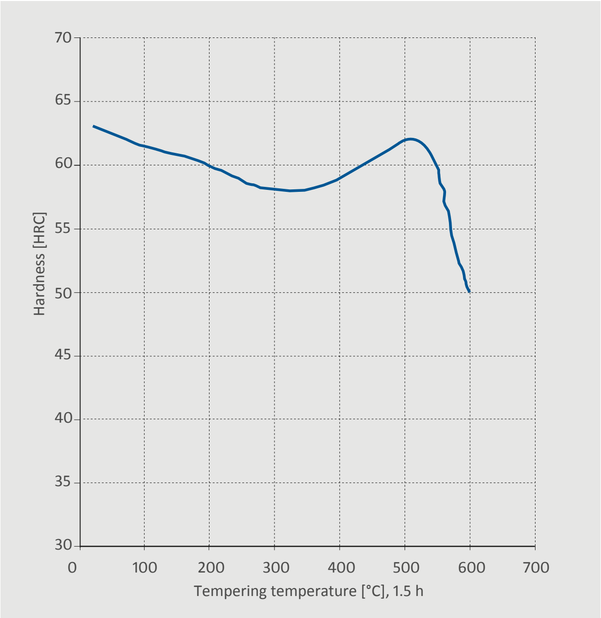
HEAT TREATMENT

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 TEMP.	COOLING
150 °C/h - 250 °C/h	Min.180	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



Recommended working hardness for cutting and forming is up to 62 HRc.

TIP 3

For complex parts avoid high hardening temperatures in combinations with low tempering temperatures. High temperature tempering is always recommended for large cross sections.

DIMENSIONAL CHANGES DURING HARDENING AND TEMPERING

It is recommended to leave machining allowance before hardening of minimum 0.15 % of dimension, equal in all three directions.

WELDING AND EDM

NOTES

WELDING

RS 220 RAVNEX 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	~400 °C	Approximately 30°C/h to not less than 70°C, then tempering.

WELDING METHOD	FILLER MATERIAL	HARDNESS AFTER WELDING
MMA, TIG	8% Cr - type	~ 58 HRC*

*Depends on the type of consumables

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. It is critical to perform tempering of re-hardened and yet untempered layer underneath the surface.

RECOMENDATIONS FOR MACHINING

NOTES

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

DRILLING

INSERT	DRILL DIAMETER (mm)	CUTTING SPEED (m/min)	FEED (mm/rev)
HSS	5 - 20	15	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)	120 - 180	0.2 - 0.4	2.0 - 4.0
P20 c.*(fine milling)	190 - 220	0.1 - 0.2	- 2.0

TURNING

INSERT	CUTTING SPEED (m/min)	FEED (mm/rev)	DEPTH OF CUT (mm)
P20 c.*(rough turning)	105 - 150	0.20 - 0.4	2.0 - 4.0
P15 c.*(fine turning)	155 - 200	0.05 - 0.2	- 2.0
HSS (fine turning)	18 - 20	0.05 - 0.3	- 2.0

* C - Coated carbide

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