sij | ravne steel

COLD WORK TOOL STEEL

RS 200

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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

RS 200

CONTENTS

GENERAL CHARACTERISTICS

NOTES

RS 200 is a quality, ledeburitic chromium cold work tool steel produced in METAL RAVNE. Tool steel RS 200 is known for its:

- **High abrasive wear resistance**
- **High compressive strength**
- **High dimensional stability**
- **Moderate toughness**
- **Deep hardenability**
- **Tempering resistance**
- **Suitable for EDM**
- **Nitrability**

→ RS 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 200	D2	1.2379	1.55	0.25	0.30	11.50	0.70	1.00

Chemical element content is in wt %

→ RS APPLICATION

RS 200 is used as high performance steel where abrasive wear is dominant. Grade is mainly used for blanking and punching of thinner (6 mm) and harder work material. It is recommended for forming applications like bending, deep drawing, and thread rolling.

RS 200 can be used for plastic molding applications in the case of abrasive plastics as also for shredding blades for plastics.

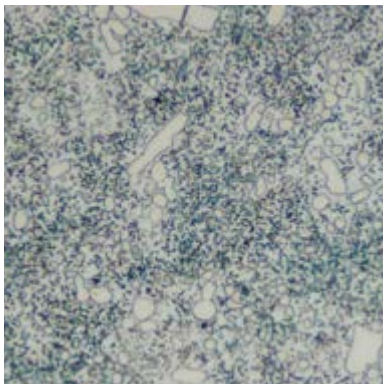
NOTES

GENERAL CHARACTERISTICS

MICROSTRUCTURE IN DELIVERED CONDITION

RS 200 is supplied in annealed condition, max. 250 HBW (840 N/mm²).

RS 200 is inspected in soft annealed condition. Improved carbide distribution and homogeneity of this steel improves working life and gives a substrate suitable for additional surface treatments like nitriding or PVD.



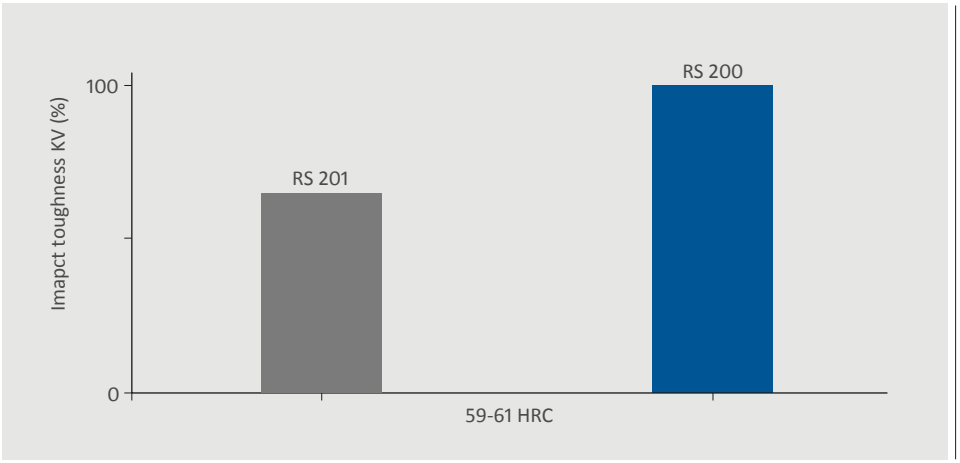
500 ×

NOTES

GENERAL CHARACTERISTICS

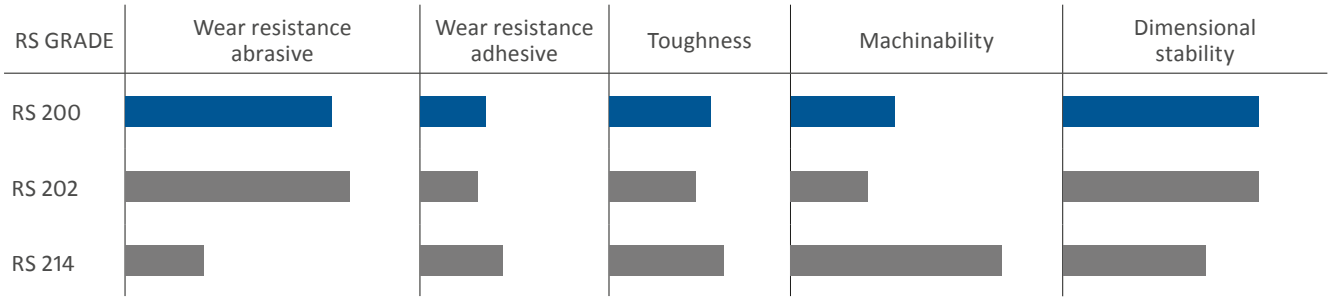
→ TOUGHNESS

RS 200 is a steel with moderate toughness.



→ QUALITATIVE COMPARISON

RS 200 has higher abrasive wear resistance compared to RS 202 and compared to universal RS 214.



PHYSICAL PROPERTIES

NOTES

PHYSICAL PROPERTIES

DENSITY (g/cm³)

7.70 (20 °C)	* 400 °C)	* (500 °C)	* (550 °C)	* (600 °C)

THERMAL CONDUCTIVITY (W/(m.K))

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

ELECTRIC RESISTIVITY (Ohm.mm²/m)

0.65 (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)*

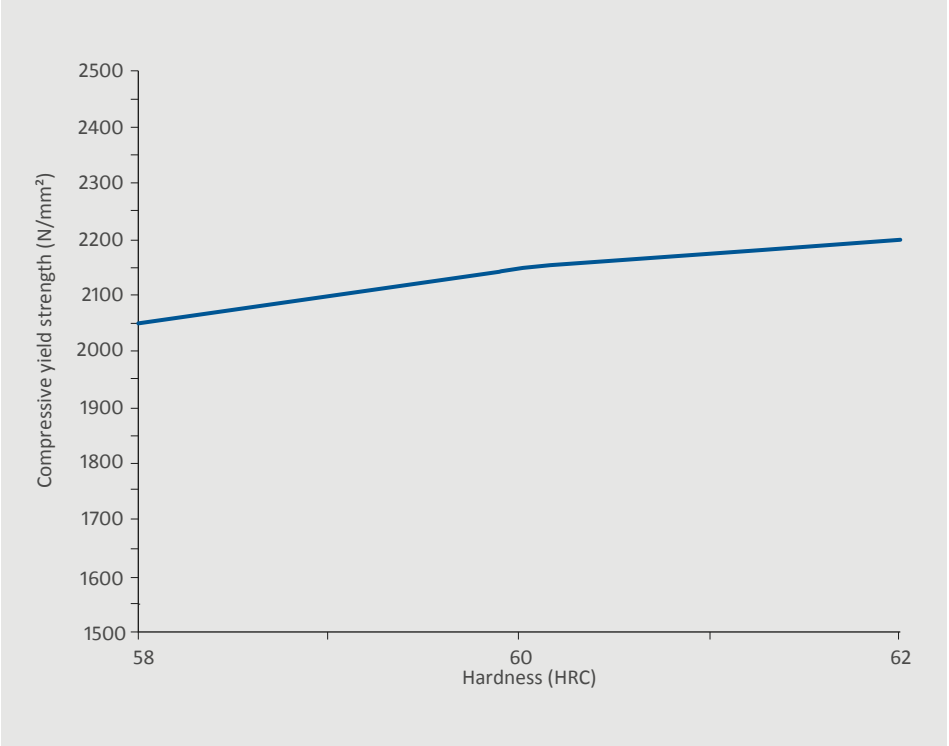
9.80 (100 °C)	11.70 (200 °C)	12.10 (300 °C)	12.80 (400 °C)	12.90 (500 °C)

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

MECHANICAL PROPERTIES

NOTES

→ COMPRESSIVE YIELD STRENGTH



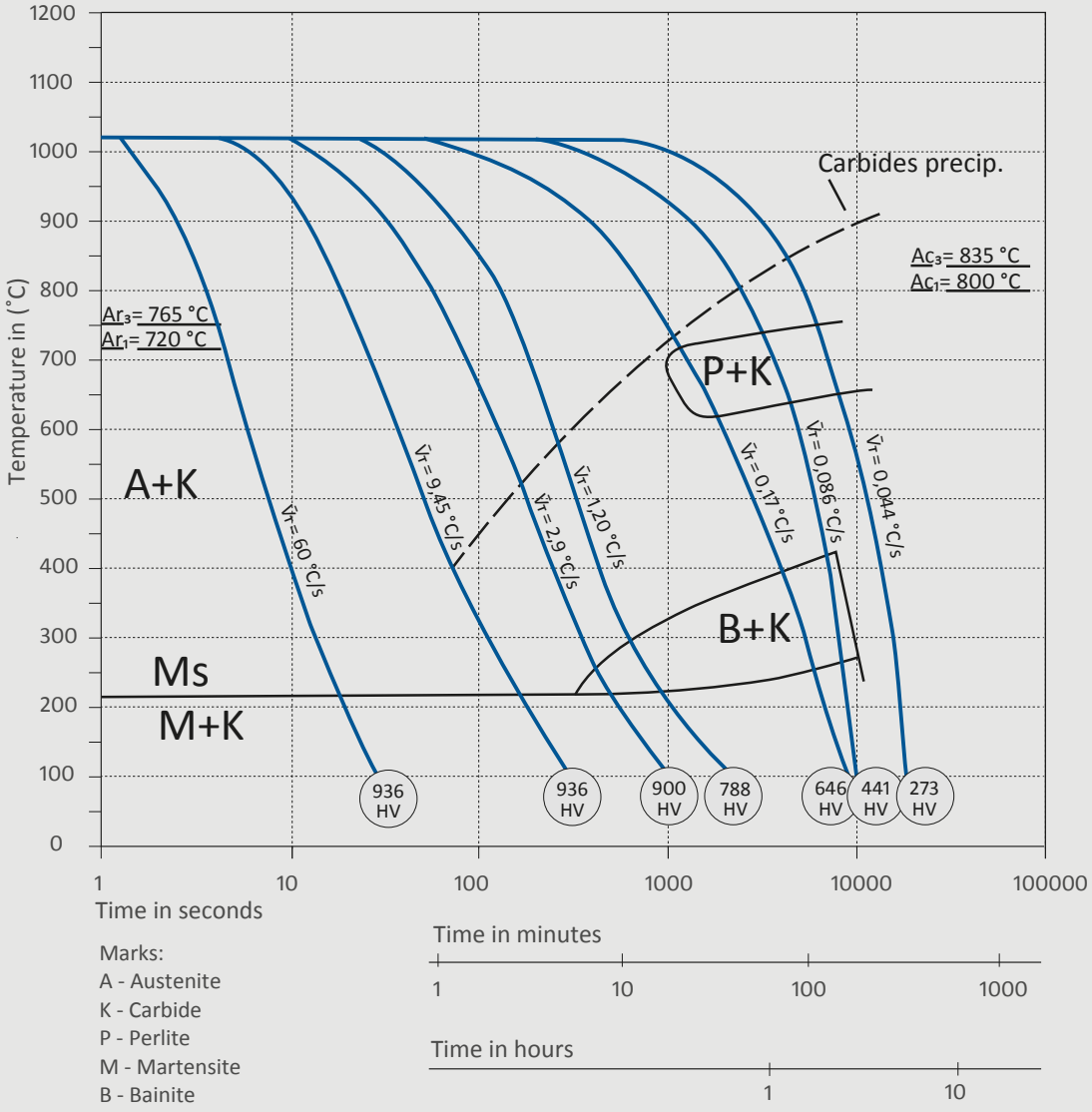
← Chart shows compressive yield strength, Rc02, in dependence to hardness.

CONTINIOUS COOLING CURVES - CCT

NOTES

RS 200

Austenitising temperature: 1020 - 1050 °C, soak time: 30 - 60 min



Marks:
A - Austenite
K - Carbide
P - Perlite
M - Martensite
B - Bainite

TIP 1 → **To improve in/service life of cutting tooling it is important to balance the final hardness of a tool relative to the thickness of the work piece processed.**

HEAT TREATMENT

NOTES

Recommendations.

→ ANNEALING

HEATING	ANNEALING TEMP.	COOLING
50 °C/h	840 - 880 °C	10 - 20 °C/h
Protect against oxidation, scaling and decarburisation.	2 hours.	Slow in the furnace. From 600 °C cooling in air

→ 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 62-64 HRC

HEATING	AUSTENITISING	COOLING
25 - 600 °C, 150-220 °C/h 600 - 850 °C, ≤150 °C/h 850 - 1020 °C, ≤150 °C/h	1020 - 1050 °C	See CCT diagram
Hold in furnace at T = 600 °C / 850°C until $T_{SURFACE}$-T_{CORE} ≤ 100 °C / 50 °C.	$T_{SURFACE}$ is measured at 15mm underneath surface, soak time 30 - 60 min.	

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

NOTES

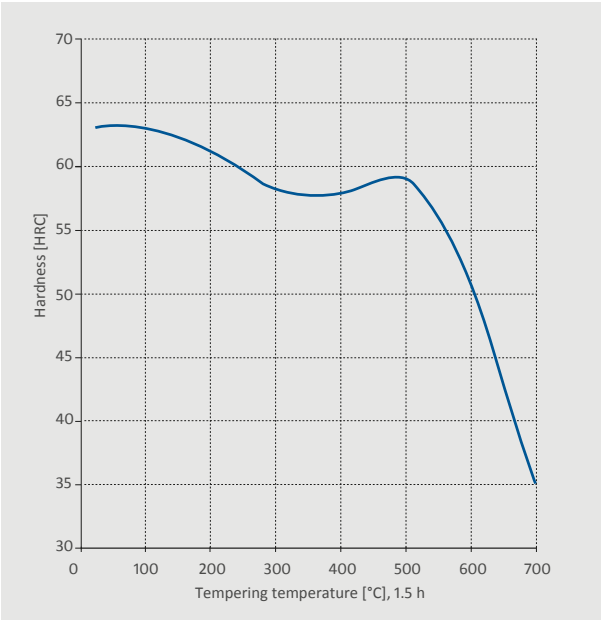
HEAT TREATMENT

→ TEMPERING

Tempering must start immediately after completion of quenching (when part reaches 90-70°C).
Minimum 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 combination with low tempering temperatures. High tempering temperature is always recommended for parts with 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 200 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 previous 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	~250 °C	Approximately 30°C/h to not less than 70°C, then tempering.

WELDING METHOD	FILLER MATERIAL	HARDNESS AFTER WELDING
TIG, MMA	12 %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 temper the re-hardened and yet untampered layer underneath the EDM 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 (in mm)	CUTTING SPEED (m/min)	FEED (mm/rev)
HSS	5 - 20	10	0.05 - 0.35
Coated HSS	5 - 20	20	0.05 - 0.35

FACE MILLING

INSERT	CUTTING SPEED (m/min)	FEED (mm/tooth)	DEPTH OF CUT (mm)
P20 c.* (rough milling)	95 - 120	0.2 - 0.4	2.0 - 4.0
P20 c.* (fine milling)	140 - 180	0.1 - 0.2	- 2.0

TURNING

INSERT	CUTTING SPEED (m/min)	FEED (mm/rev)	DEPTH OF CUT (mm)
K20 c.* (rough turning)	110 - 150	0.20 - 0.4	2.0 - 5.0
K20 c.* (fine turning)	155 - 200	0.05 - 0.2	- 2.0
HSS (fine turning)	12 - 14	0.05 - 0.3	- 2.0

* C - Coated carbide

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