

# Ralloy® WR13

## P/M tool steel

Ralloy® WR13 is an extra high chromium alloyed P/M-tool steel. Due to high volume of fine uniformly distributed hard carbides it has an excellent wear resistance with good toughness. The very high chromium content ensures good corrosion resistance in aggressive operation environments.

### 1. Nominal composition

	C	Si	Mn	Ni	Cr	V	Mo	Ta/Nb
w-%	2,6	0,6	<0,5	0,4	26,0	2,7	1,1	1,5

### 2. Condition as supplied

Annealed	Hardness	320 HB
Hardened and tempered	Hardness	52-63 HRC

### 3. Mechanical Properties

Compressive strength

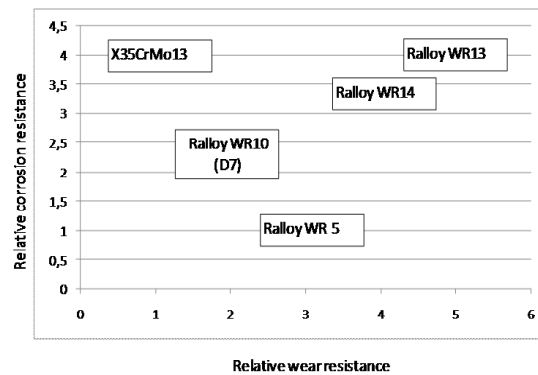
Heat Treatment	Hardness HRC	Compressive Strength MPA
Aust. 1100 °C, oil quench, temper 500 °C	63	3500
Aust. 1150 °C, oil quench, temper 500 °C	62	3950
Aust. 1150 °C, oil quench, temper 550 °C	58	3550

Unnotched izod impact values

Heat treatment	Average impact values Joules
Austenizing 1150 °C, tempering 500 °C	10J

### 4. Wear and corrosion resistance

Due to high volume of hard chromium, vanadium and niobium carbides and the uniform fine microstructure the abrasion resistance of WR13 is superior to conventional stainless wear resistant steels and most PM-tool steels. The high chromium level in the matrix results in excellent corrosion resistance.



## 5. Heat treatment

Annealing: 900 °C, hold 4 hours, slow cool 12 °C/h to 540 °C. Then air or furnace cool.

Stress relieving: 650-750 °C, hold 2 hours, cool with furnace.

Hardening: In salt bath, vacuum or protective atmosphere. 1010-1175 °C, hold time at temperature 30-60 min.

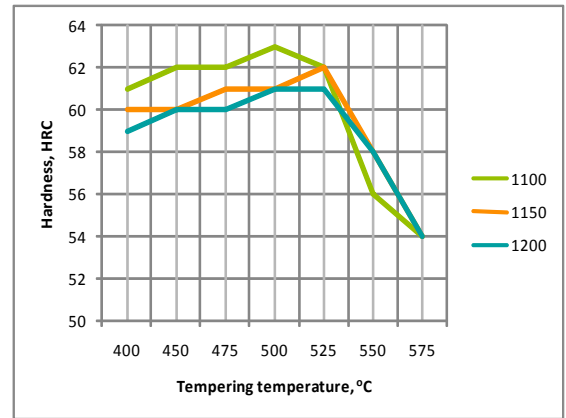
Quench: Salt or oil quench to 540-595 °C. Equalize, then cool to below 50 °C or quench by nitrogen gas (4 bar min).

Temper: Double or triple tempering, 400-560 °C min. hold time 2 hours.

Hardness after tempering 46-65 depending on annealing temperature and tempering temperature.

Size change during hardening: 0.010 mm/mm.

Tempering temperature °C	Austenizing temperature Hardness HRC		
	1100°C	1150°C	1200 °C
400	61	60	59
450	62	60	60
475	62	61	60
500	63	61	61
525	62	62	61
550	56	58	58
575	54	54	54



## 6. Machining

Process	Width of tooling or cutting depth	High speed steel machining		Tungsten carbide machining		Grade
		Speed	Feed	Speed	Feed	
	(mm)	m/min	mm/rev.	m/min	mm/rev.	
Turning	Rough mach.	10	0,3	40-50	0,2-0,4	K20, P10-P20
	Finish mach.	12	0,2	50-70	0,1-0,2	
Drilling	Drill diameter					K20, P20
	-5	8	0,05-0,15	50*	0,05-0,15	
	5-10	8	0,15-0,20	50	0,15-0,20	
	10-15	8	0,20-0,25	50	0,20-0,25	
Milling	2-4 Rough mach.	10-15		40-50		
	2 Finish mach.	15-20		50-60	0,2	
Machining lubricant		Light sulphur oil		Water soluble oil		

\*Solid carbide

## 7. Typical applications

Applications requiring high abrasion and corrosion resistance, e.g. plastics and rubber industry, food industry and glass industry.

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