BÖHLER

COLD WORK TOOL STEEL

POWDER METALLURGY

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BÖHLER K390 MICROCLEAN®

voestalpine BÖHLER Edelstahl GmbH & Co KG
www.voestalpine.com/bohler-edelstahl

voestalpine
ONE STEP AHEAD.

PEAK PERFORMANCE

BOOST YOUR PRODUCTIVITY TO NEW HEIGHTS

Just as mountaineers need the best equipment to conquer the highest peaks, it's essential to use the best materials for your tooling to ensure trouble-free production and achieve **outstanding** tool life.

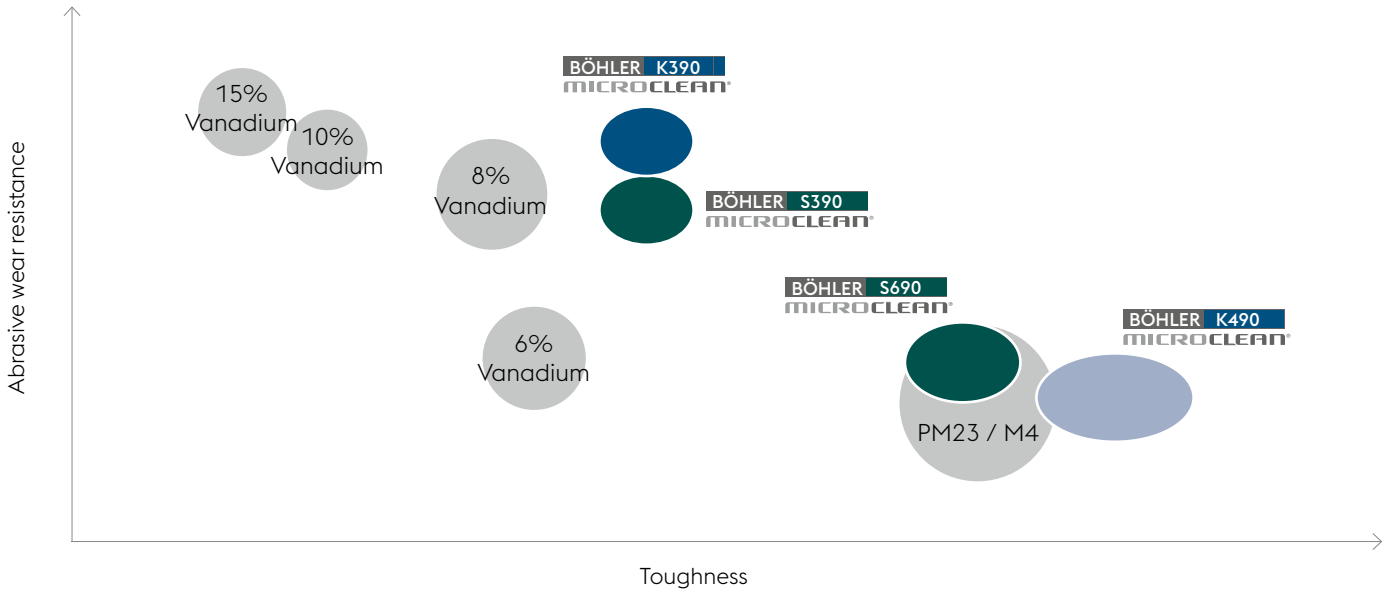
Three reasons why BÖHLER K390 MICROCLEAN is highly cost effective:

» Extremely high wear resistance
» Excellent toughness
» Very high compressive strength

The high-performance powder-metallurgy steel **BÖHLER K390 MICROCLEAN** is a reliable solution for your difficult cutting, die-cutting and cold forming operations, and it has a very good track record for applications in the plastics industry.

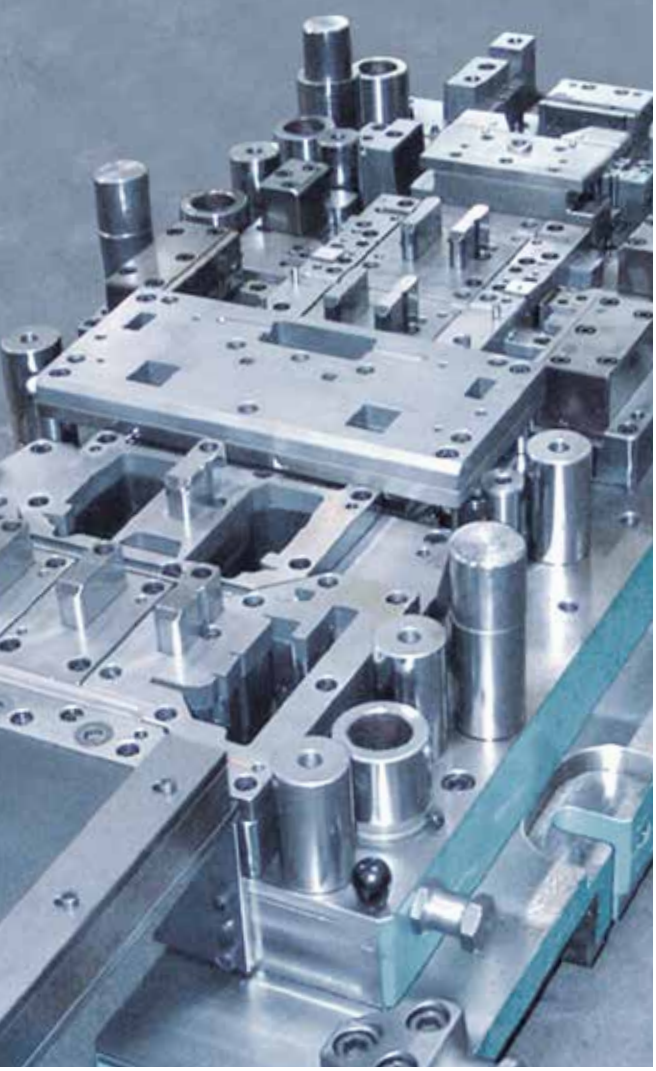
Coverfoto:
stamfag

Product positioning (schematic)



Chemical composition (nominal in wt.%)

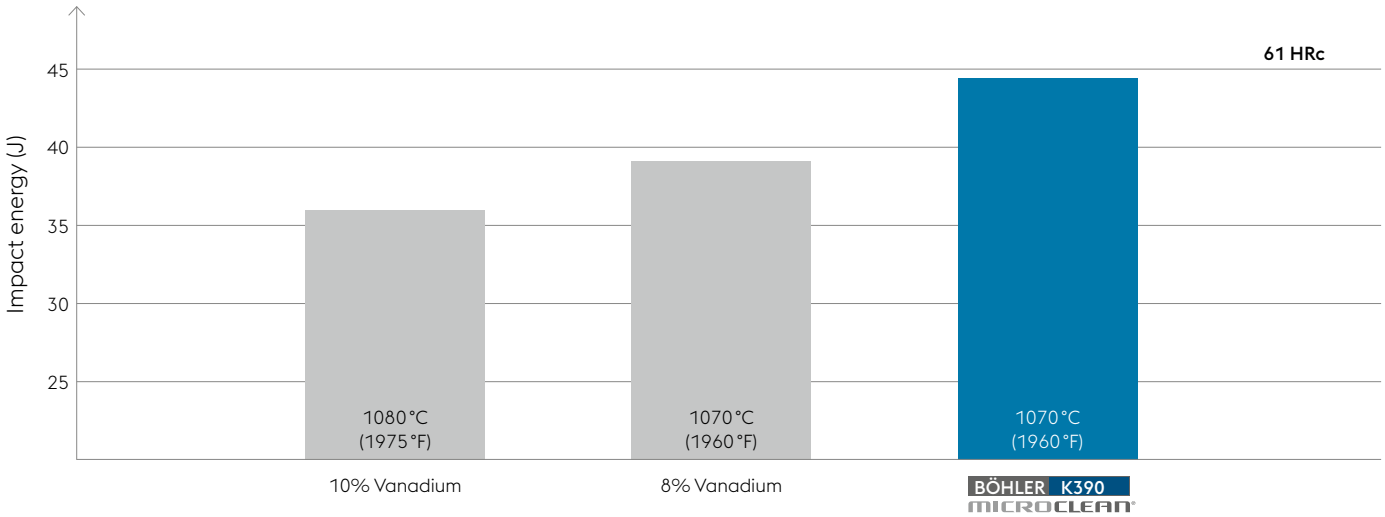
C	Si	Mn	Cr	Mo	V	W	Co
2.47	0.55	0.40	4.20	3.80	9.00	1.00	2.00



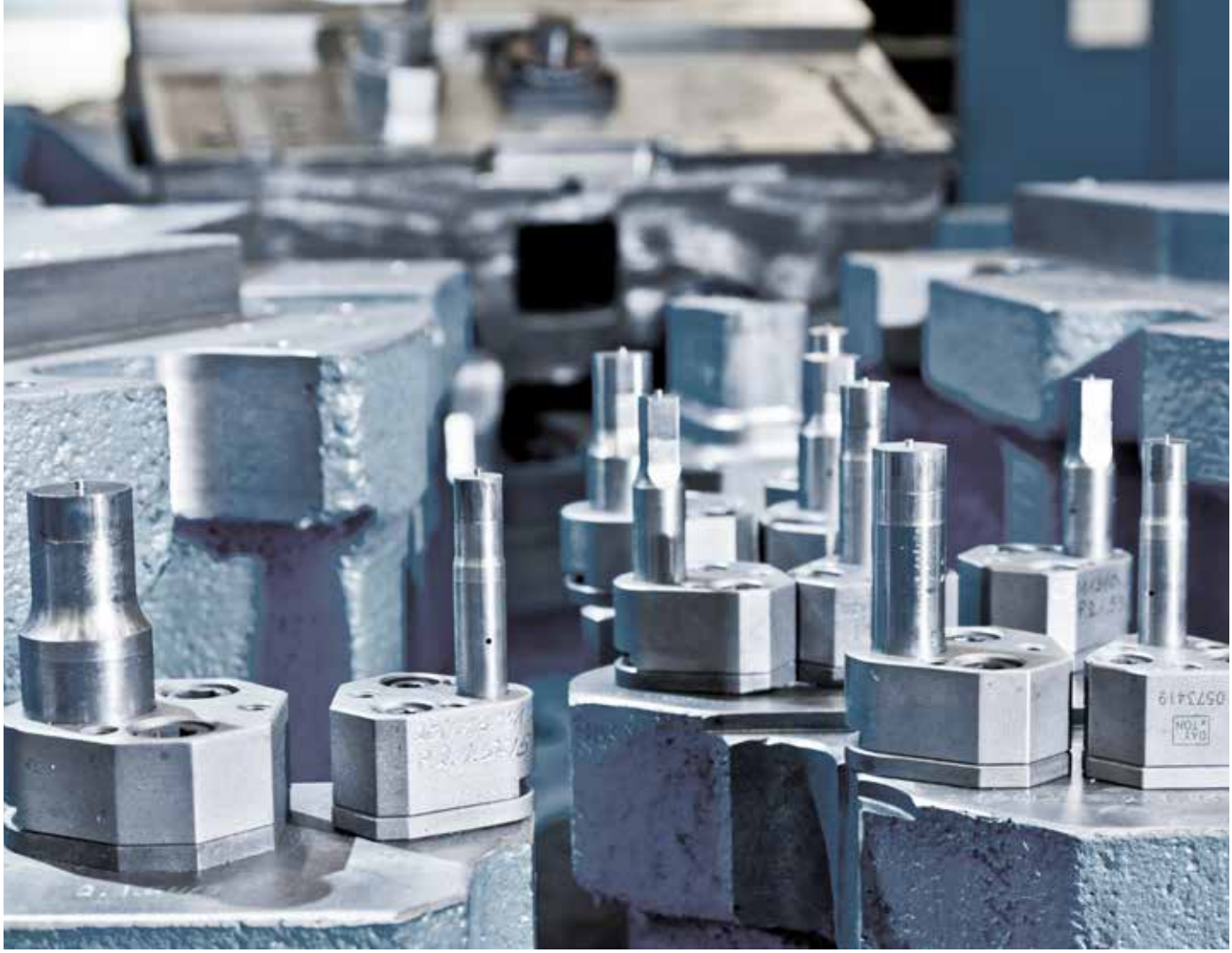
EXCELLENT PROPERTIES

Compared to similar grades from other sources, **BÖHLER K390 MICROCLEAN** is highlighted by its excellent toughness properties that significantly reduce the risk.

Impact energy

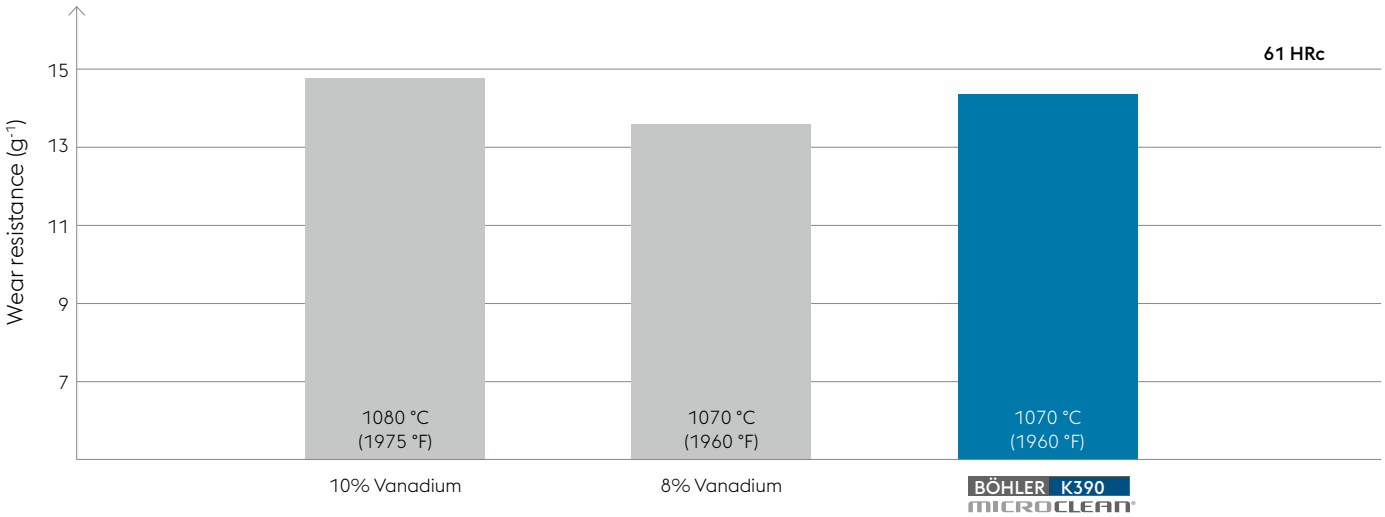


Specimens taken from rolled steel bar in longitudinal direction, centre
Source material dimensions: 40.8 mm round
Specimen size: 7 x 10 x 55 mm per SEP 1314



Abrasive wear resistance is improved by higher vanadium content, which boosts the number of hard carbides content of the material.

Wear resistance



Values determined by SiC sandpaper test
Specimens taken from rolled steel bar in cross direction, centre
Source material dimensions: 40.8 mm round
Specimen size: Ø 8 x 16 mm against SiC paper P120, Ra < 0.8 µm

PROPERTIES AND BENEFITS

Benefits for tool & die production
in comparison to 10V PM

» **Good machinability**
because of uniform mechanical properties

» **Excellent grindability**
even with deep engraving in the tool & die centre

» **Uniform low dimensional change**
during heat treatment

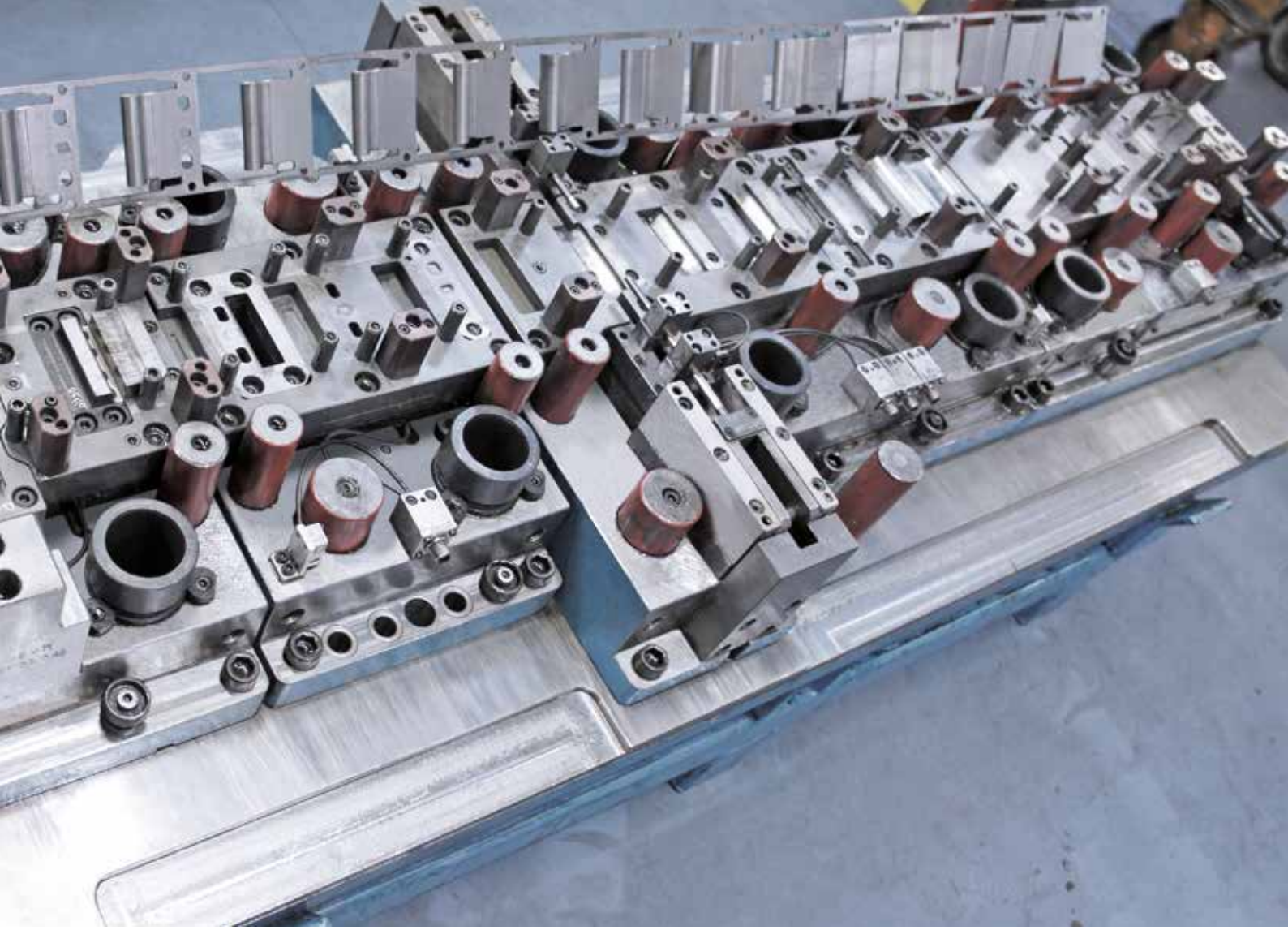
» **Non sensitive against overheating**
or long soak times

» **Optimal EDM characteristic**
due to uniform carbide distribution

Benefits for tool & die use

» **Low unit cost**
due to longer service life

» **Safety against failure**
and cutting-edge fractures



Physical properties at 20 °C (68 °F)

Condition: hardened and tempered		
Modulus of elasticity at	20 °C 68 °F	220.4 x 10^3 N/mm^2 00.0 x 10^3 psi
Density at	20 °C 68 °F	7.6 kg/dm^3 0.274 lbs/in^3
Electrical resistivity at	20 °C 68 °F	0.59 Ohm.mm^2/m 0.98 x 10^{-3} Ohm per ft
Specific heat capacity at	20 °C 68 °F	464 J/(kg.K) 0.000 Btu/lb °F
Thermal conductivity at	20 °C 68 °F	20.1 W/(m.K) 000 Btu in/ft^2 h °F

Coefficient of thermal expansion between 20 °C (68 °F) and ....°C (°F)

100 °C	**200 °C**	**300 °C**	**400 °C**	**500 °C**	**600 °C**	
10.30	10.67	11.03	11.38	11.70	11.97	10^{-6} m/(m.K)
210 °F	**390 °F**	**570 °F**	**750 °F**	**930 °F**	**1110 °F**	
6.78	6.94	7.22	7.33	7.61	7.78	10^{-6} in/(in °F)

Source: Materials Center Leoben Forschung GmbH, ÖGI

APPLICATIONS

BÖHLER K390 MICROCLEAN performs well in a wide variety of applications due to its outstanding properties.

Die-cutting and stamping
» Cutting tools (dies and stamps), standard and fine blanking
» Die rolls

Cold forming
» Pressure-flow dies (cold and semi-hot)
» Drawing and deep-drawing dies
» Embossing dies
» Thread-rolling dies
» Cold rolls for multi-roll frames
» Cold-piercing mandrels
» Pressing dies for the ceramic and pharmaceutical industries
» Sinter pressing dies

Knives
» Paper and cardboard industry
» Circular knives for web slitters
» Knives for the recycling industry
» Shear blades for cutting thin material

Plastics
» Extrusion cylinders and feedscrews
» Mould inserts
» Injection nozzles
» Check valves

HEAT TREATMENT RECOMMENDATIONS

Choose the right heat treatment for optimal results.

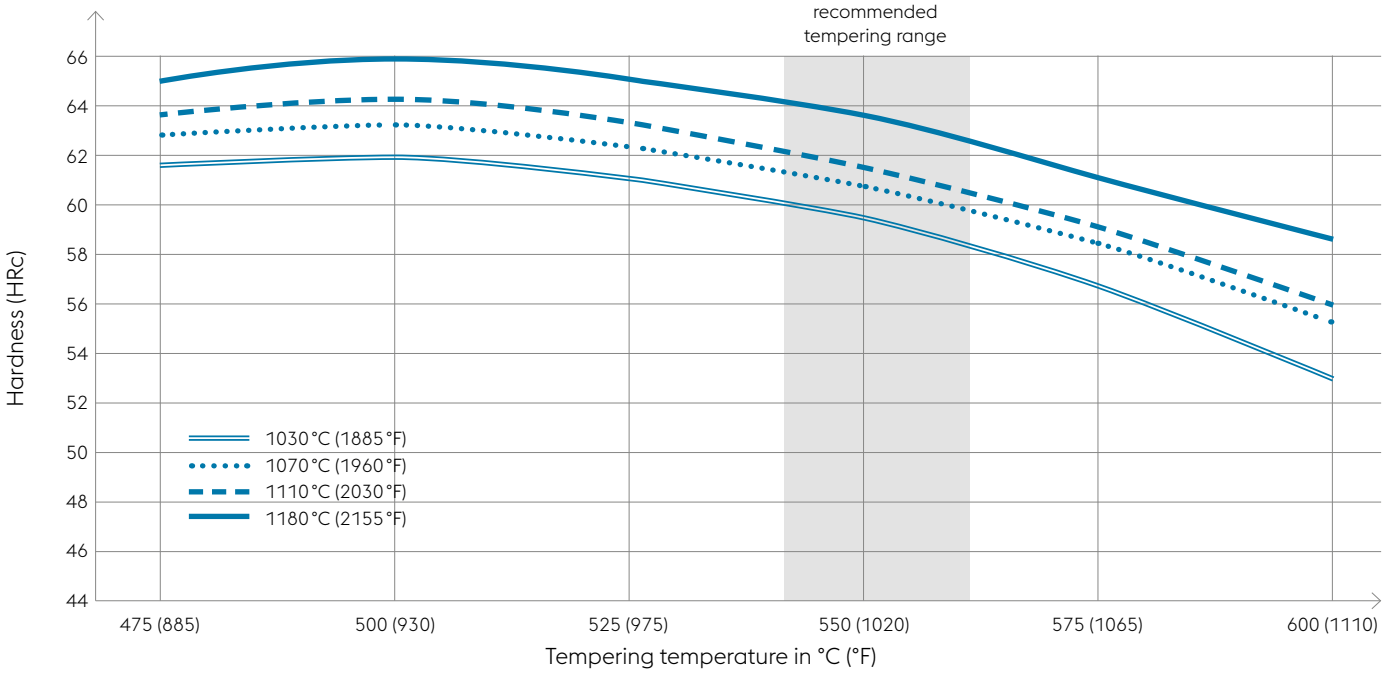
Soft annealing
» Hardness after annealing: 280 HB max.

Stress relieving
» 650 to 700 °C
» Once heated completely through, soak in neutral atmosphere at temperature for 1 to 2 hours
» Slow cooling in furnace

Hardening
» 1030 to 1180 °C / oil, N_2
» Once heated completely through:
  • 20 – 30 min (hardening temperature 1030 – 1150 °C)
  • 10 min (hardening temperature 1180 °C)
» For high toughness, use a low hardening temperature.
» For high wear resistance, use a high hardening temperature.

Tempering
» Heat up slowly to the tempering temperature immediately after hardening
» Soak time in furnace 1 hour for each 20 mm of workpiece thickness, with a minimum of 2 hours
» Air/gas quenching
» Triple tempering is recommended
» Achievable hardness range: 58 – 64 HRc

Tempering chart

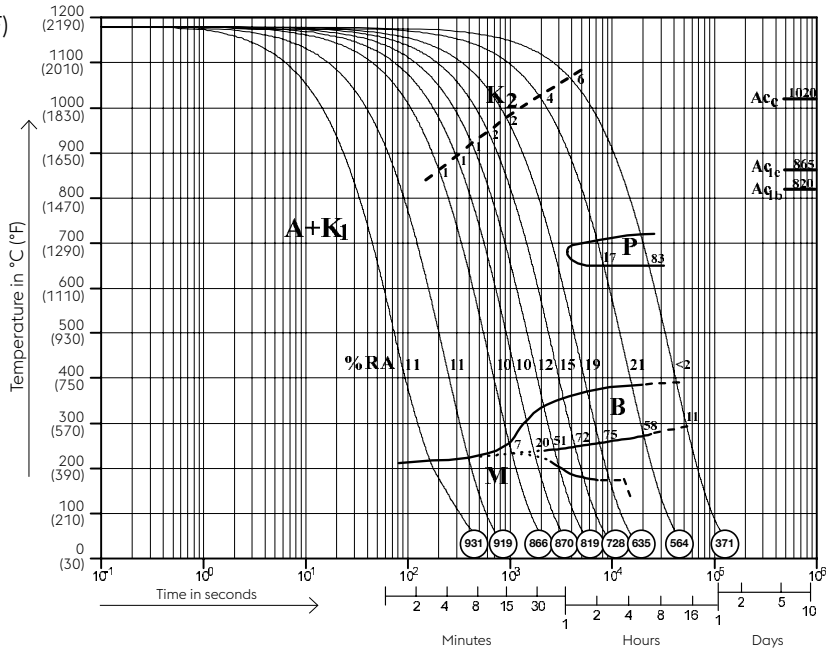


hardened in vacuum furnace: N_2 cooling, 5 bar
bei 3 x gleicher Anlasstemperatur

HEAT TREATMENT RECOMMENDATIONS

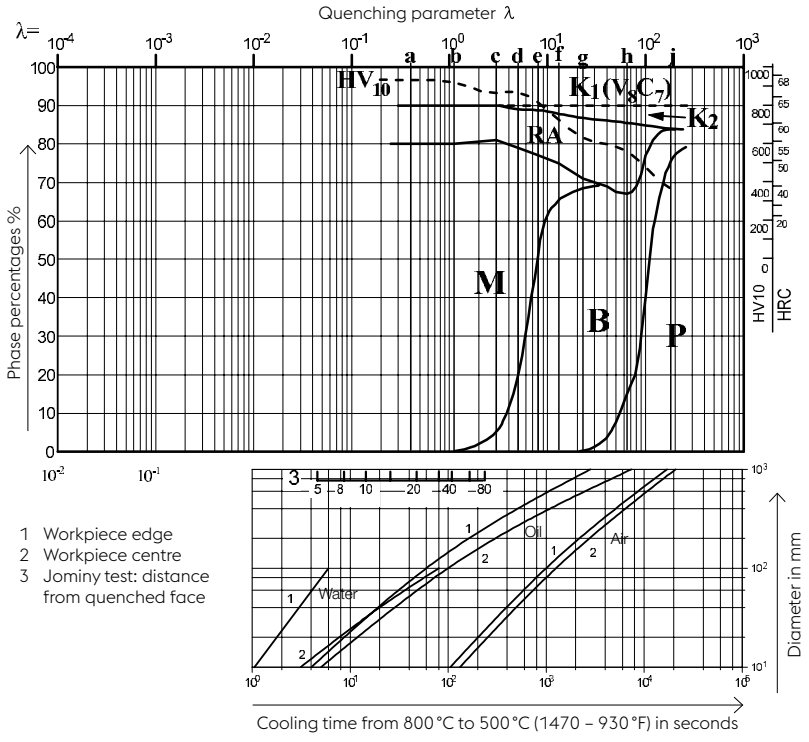
CCT chart for continuous quenching

Austenitization temperature: 1180 °C (2155 °F)
Soak time: 5 minutes
0.4 ... 180 Quenching parameter λ, quenching time from 800 to 500 °C (1470 – 930 °F) in s x 10^{-2}



Quantitative phase diagram

K1 Carbides not dissolved during austenitization (10%)
K2 Start of carbide precipitation during quenching from austenitizing temperature
LK Ledeburitic carbides
RA Retained austenite
A Austenite
M Martensite
P Perlite
B Bainite



MACHINING INSTRUCTIONS

Turning with carbide tools

Cutting depth (inches)	0.5 – 1 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)	over 8 (.31)
Feed (inches/rev.)	0.1 – 0.3 (.004 – .012)	0.2 – 0.4 (.008 – .016)	0.3 – 0.6 (.012 – .024)	0.5 – 1.5 (.020 – .060)
ISO grade	P10, P20	P10, P20, M10	P30, M20	P30, P40
Cutting speed v_c (m/min) (f.p.min.)				
Indexable inserts **Tool life: 15 min.**	210 – 150 (690 – 490)	160 – 110 (525 – 360)	110 – 80 (360 – 260)	70 – 45 (230 – 150)
Brazed carbide tools **Tool life: 30 min.**	150 – 110 (490 – 360)	135 – 85 (445 – 280)	90 – 60 (295 – 195)	70 – 35 (230 – 115)
Coated indexable inserts **BÖHLERIT LC P25 T** **BÖHLERIT LC 240 F**	 up to 250 (820) up to 200 (655)	 up to 250 (820) up to 200 (655)	 up to 250 (820) up to 180 (590)	 up to 250 (820) up to 180 (590)
Tool geometry for brazed carbide tools **Rake angle** **Clearance angle** **Inclination angle**	 6° – 12° 6° – 8° 0°	 6° – 12° 6° – 8° -4°	 6° – 12° 6° – 8° -4°	 6° – 12° 6° – 8° -4°

Condition: soft annealed, figures given are guidelines only

Drilling with carbide bits

Drill bit diameter (inches)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed (inches/rev.)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BÖHLERIT/ISO carbide grade	HB10 / K10		
Cutting speed v_c (m/min) (f.p.min.)	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)
Point angle	115° – 120°	115° – 120°	115° – 120°
Clearance angle	5°	5°	5°

Milling with insert cutter heads

Feed (inches/tooth)	up to 0.2 (.008)
Cutting speed v_c (m/min) (f.p.min.)	
BÖHLERIT LC 225 T	120 – 230 (395 – 755)
BÖHLERIT LC 230 E	110 – 220 (360 – 720)
BÖHLERIT LC M45 M	100 – 200 (330 – 655)

Condition: soft annealed, figures given are guidelines only

Grinding method	annealed	hardened
Circumferential grinding	A 46 HV	B151 R50 B3* / A 46 GV**
Face grinding	A 36 GV	A 46 GV
External cylindrical grinding	A 60 KV	B151 R50 B3* / A 60 JV**
Internal cylindrical grinding	A 60 JV	B151 R75 B3* / A 60 IV
Profile grinding	A 100 IV	B126 R100 B6* / A 100 JV**

* CBN discs should be used for these applications if possible
** Grinding discs with sintered corundum should be used for these applications.

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