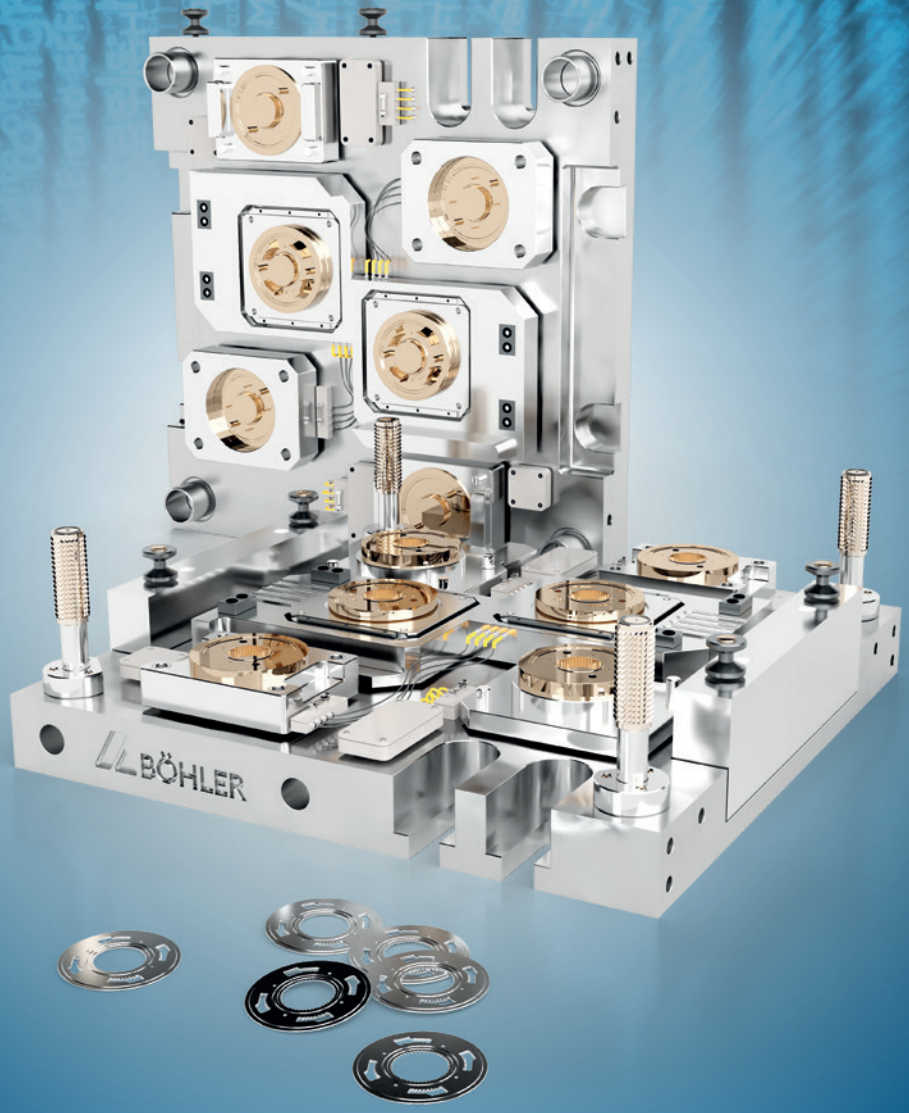
BÖHLER



COLD WORK
TOOL STEEL

COLD WORK TOOL STEEL

BÖHLER K888 MATRIX

THE WINNER

BÖHLER K888
MATRIX

DO YOU WANT TO SET NEW STANDARDS IN YOUR PRODUCTION AND BOOST PRODUCTIVITY?

BÖHLER K888 MATRIX – This MATRIX steel features an excellent combination of high toughness and high compressive strength. MATRIX materials have high toughness, which is a critical factor in many applications. However, the achievable hardness with conventional MATRIX steels often limits the potential uses. **BÖHLER K888 MATRIX** breaks this barrier and offers the best of both worlds of matrix steels and high-alloyed tool steels.

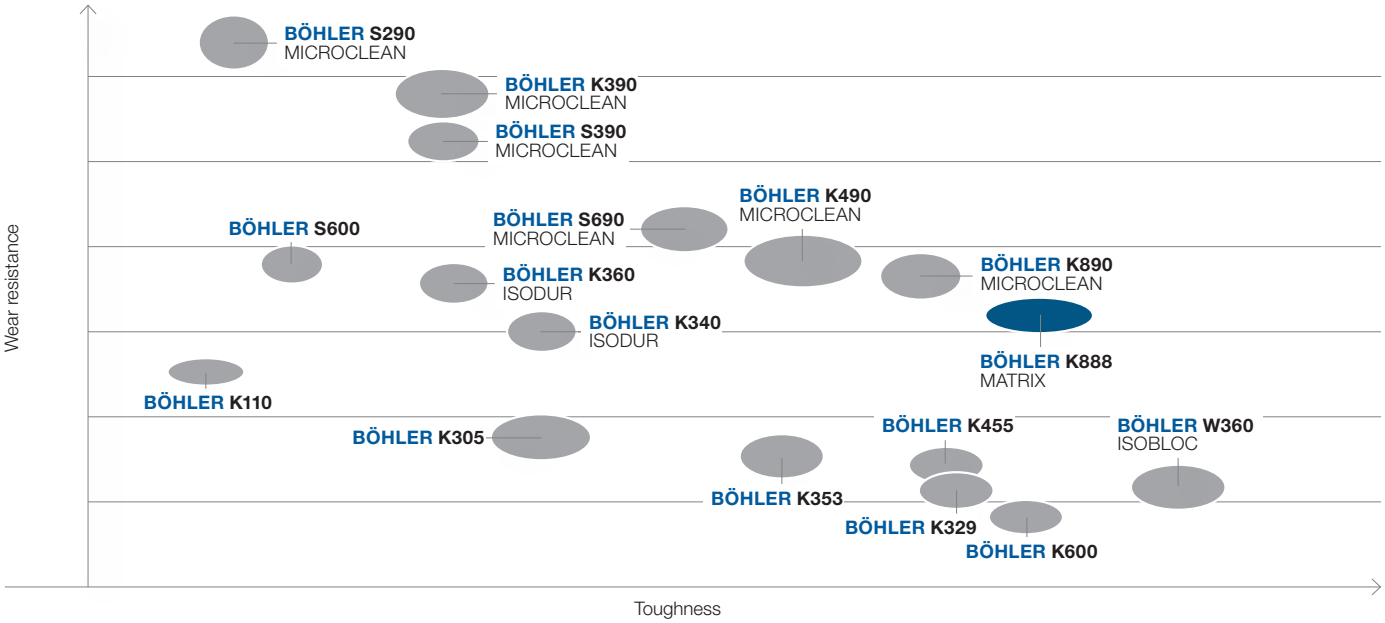
BÖHLER K888 MATRIX is a **WINNER** in situations where extremely high compressive strength and toughness are required. Its advantageous tempering behavior with a pronounced secondary hardness maximum also enables the use of advanced coatings.

IN BRIEF:

>HIGH HARDNESS

>HIGH TOUGHNESS

Positioning of popular BÖHLER grades



NOTE: This illustration is a rough overview. The product positioning depends on the respective heat treatment and the selected hardness.

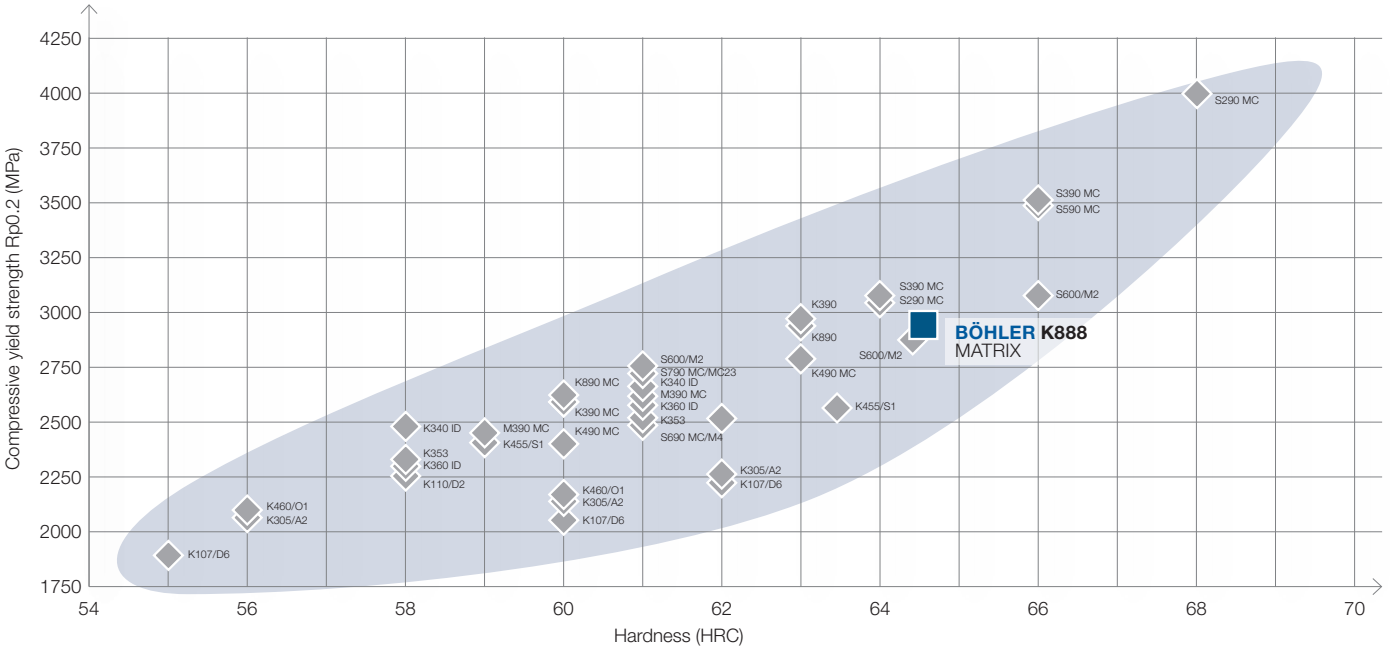
Chemical composition (reference values in weight %) / patented

C	Si	Cr	Mo	V	W	Co
0.60	0.85	4.40	2.80	1.10	2.45	3.80

EXCELLENT PROPERTIES

BÖHLER K888 MATRIX combines the benefits of conventional matrix steels and high-alloyed tool steels. The combination of high compressive strength and minimal internal defect size (primary carbides) significantly increases the fatigue strength. This results in a significant reduction in fatigue failures and longer tool life.
Wear resistance is increased by a high proportion of primary carbides. By their nature, matrix steels are at a disadvantage here, but this can be compensated by the application of coatings. With its high compressive strength and the resulting high supporting effect, **BÖHLER K888 MATRIX** is an optimal substrate for innovative coatings.

Compressive strength



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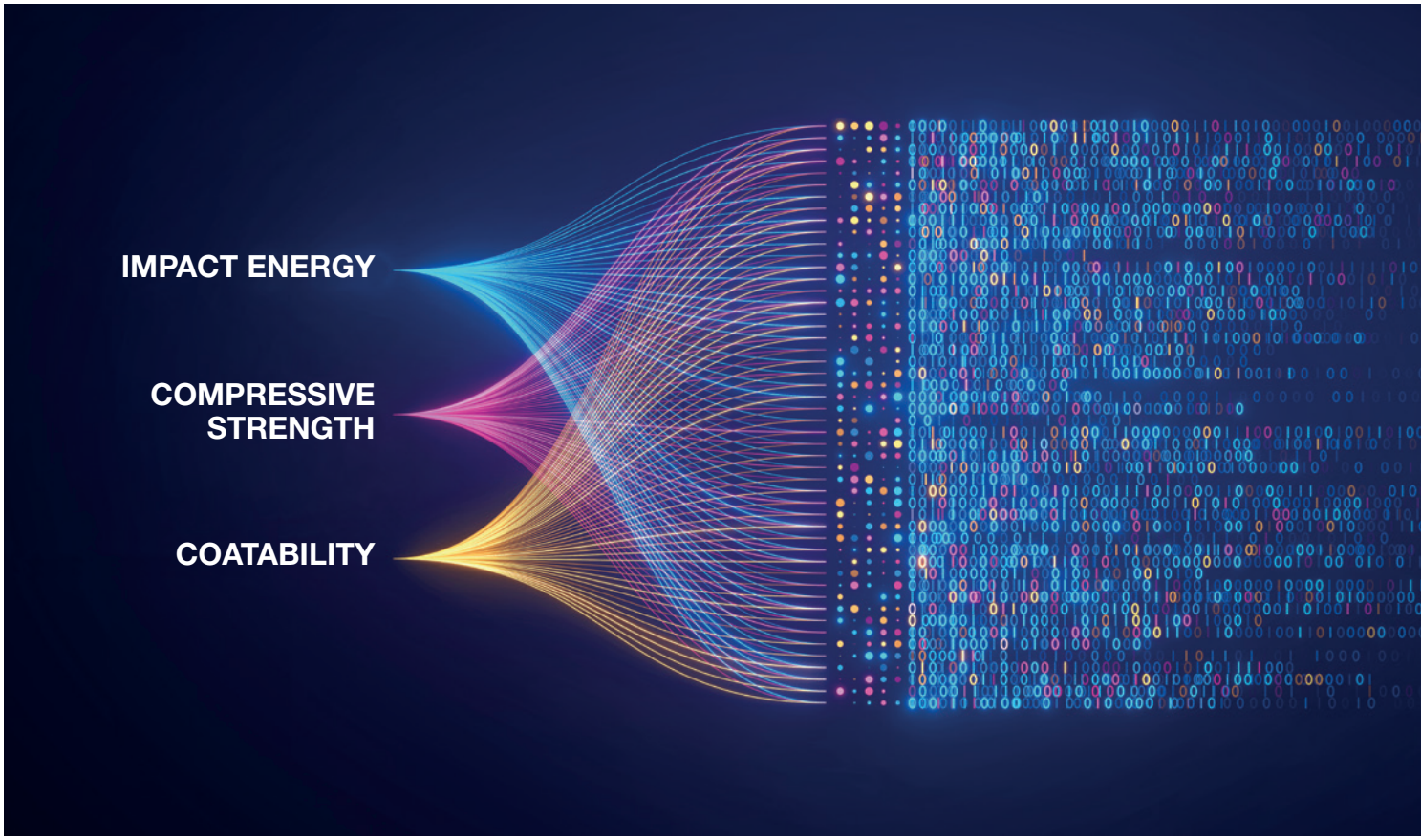
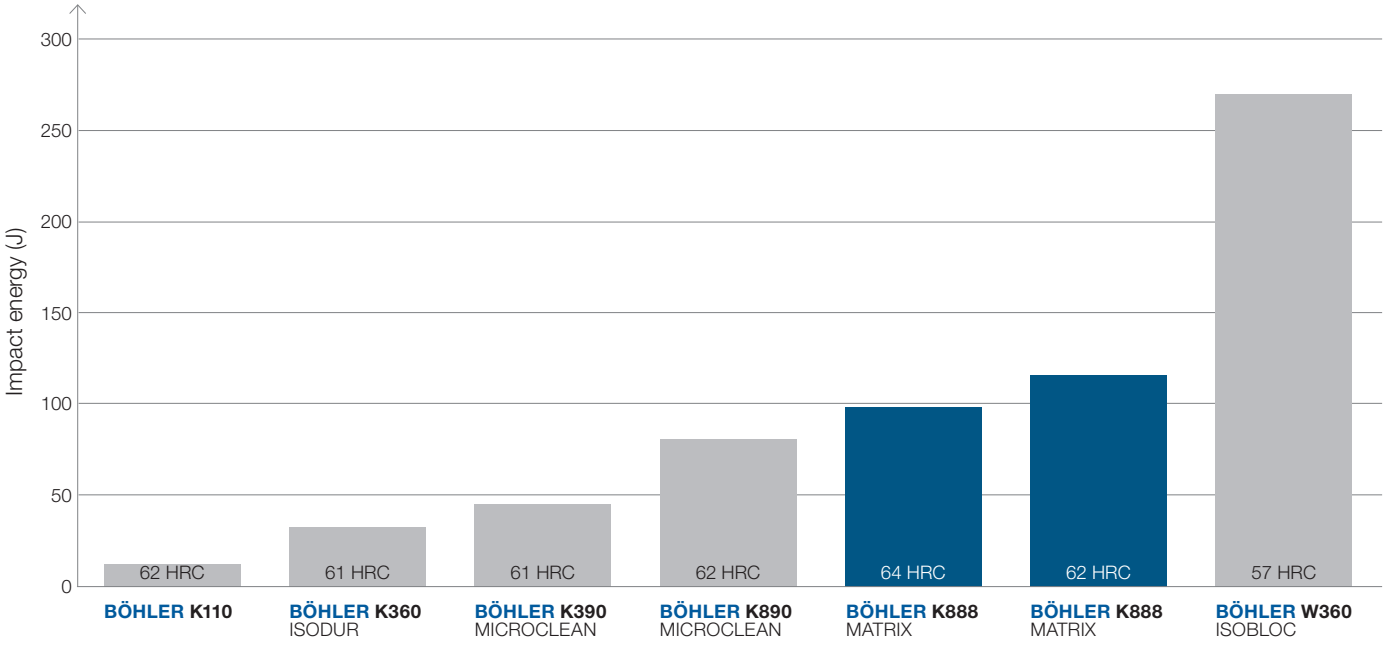


Impact energy



PROPERTIES AND BENEFITS

- Excellent toughness and ductility result in high resistance to fracture and chipping.
- Hardness: > 64 HRC
- High compressive strength
- Good machinability

This bundle of good properties makes it possible to increase the **LIFETIME** of your tools.
YOU WIN in productivity and competitiveness.

Physical properties at 20 °C (68 °F)

Condition: hardened and tempered	
Modulus of elasticity	218 10^3 N/mm² 3162 x 10^3 psi
Density	7.86 kg/dm³ 0.283 lbs/in³
Electrical resistivity	0.50 Ohm.mm²/m 2.36 x 10^{-4} Ohm per ft
Specific heat capacity	442 J/(kg.K) 0.106 Btu/(ib.°F)
Thermal conductivity	20.8 W/(m.K) 12.0 Btu/(h·ft·°F)

* Source: Materials Center Leoben Forschung GmbH, ÖGI

Thermal expansion between 20 °C (68 °F) and ....°C (°F)

100 °C	**200 °C**	**300 °C**	**400 °C**	**500 °C**	**600 °C**	**700 °C**	
10.7	11.5	11.9	12.5	12.5	12.8	12.7	10^{-6} m/(m.K)
212 °F	**392 °F**	**572 °F**	**752 °F**	**932 °F**	**1112 °F**	**1292 °F**	
5.94	6.39	6.61	6.94	6.94	7.11	7.06	10^{-6} in/(in °F)

Always **consult** BÖHLER or your dealer for any application or processing step not explicitly mentioned in this product description.

APPLICATIONS

The outstanding properties of **BÖHLER K888 MATRIX** make it a **WINNER** in many application areas:

Stamping
- Blanking tools (dies, punches), standard stamping and fine blanking
- Cutting rollers

Cold forming and shaping
- Extrusion dies (cold and semi-warm)
- Drawing and deep- drawing tools
- Embossing tools
- Tablet punches and dies for the ceramic and pharmaceutical industries
- Powder compacting dies

Knives
- Paper and cardboard industry
- Slitting knives
- Knives for the recycling industry
- Shear blades

Plastics
- Mold inserts
- Injection nozzles

HEAT TREATMENT RECOMMENDATIONS

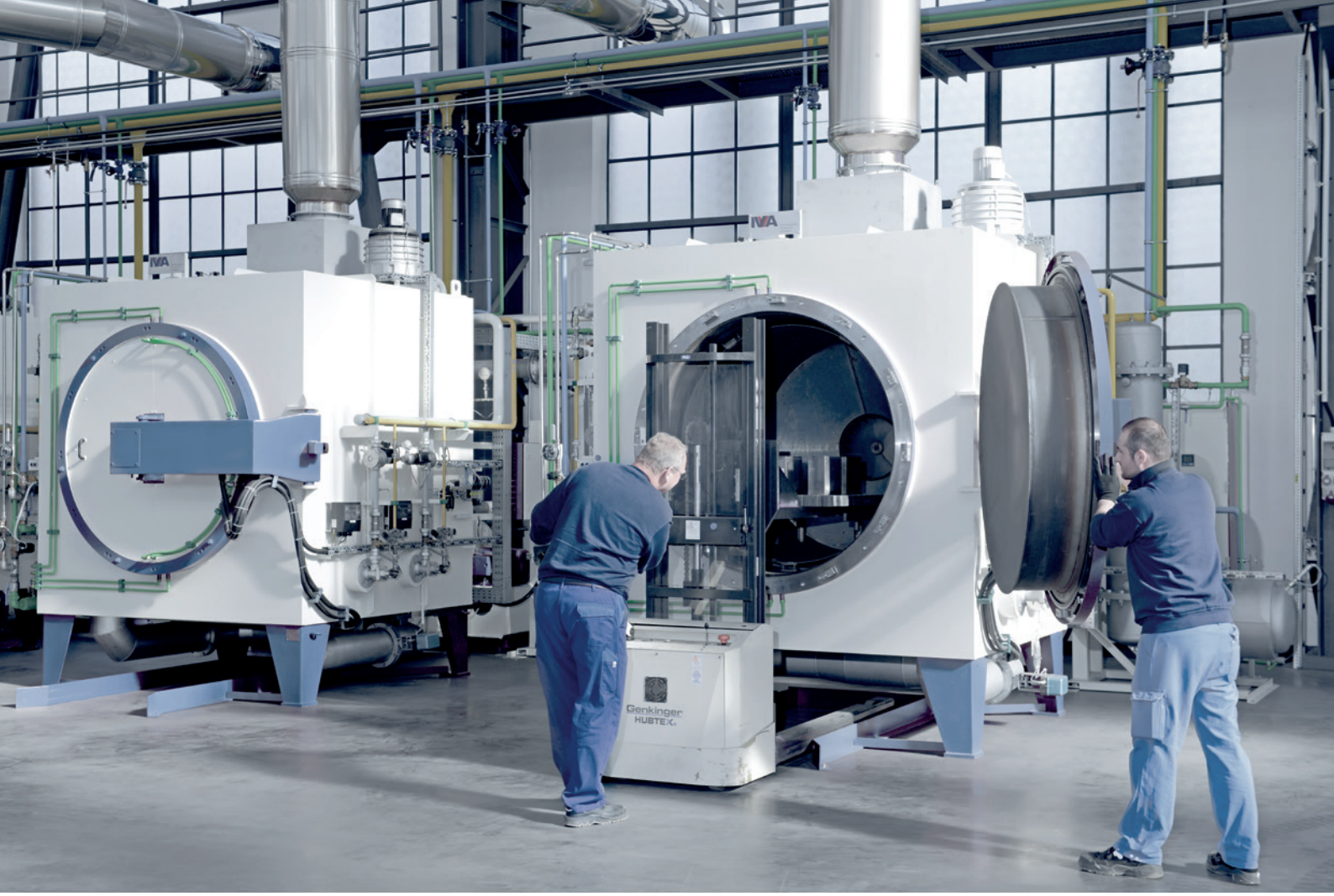
Choose the right heat treatment for optimal results.

Delivery condition
» Soft annealed, max. 280 HB

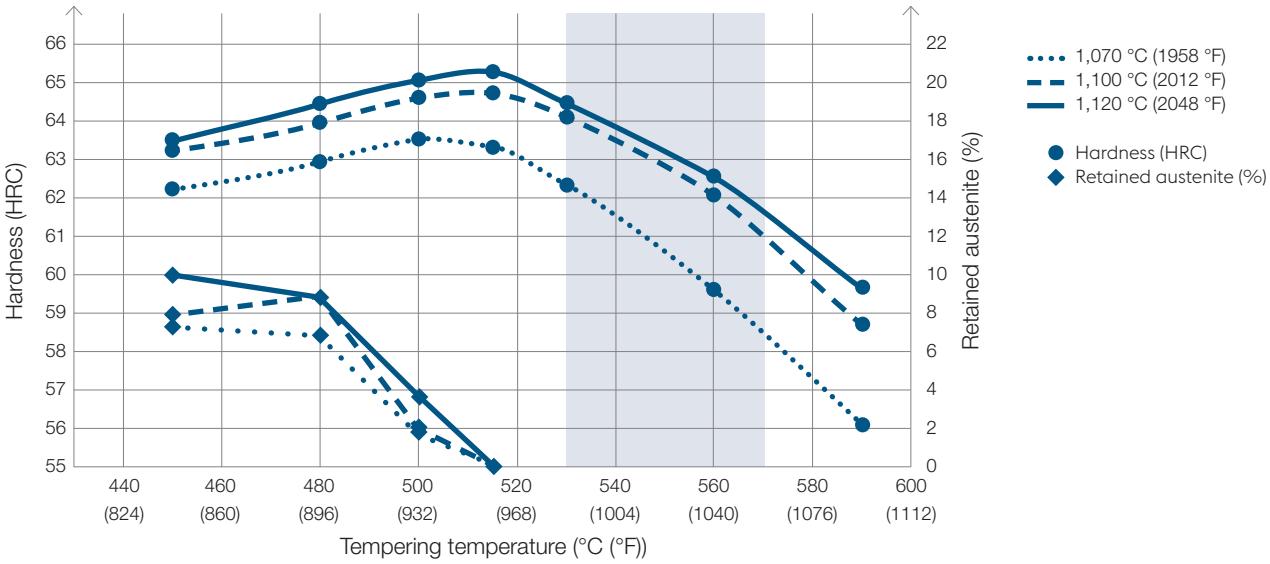
Stress relieving
» 650 °C to 700 °C (1202 to 1292 °F)
» Once heated completely through, soak in neutral atmosphere at temperature for 1 to 2 hours
» Slow cooling in furnace.

Hardening
» 1070 °C to 1120 °C / oil, N_2 (1958 °F to 2048 °F)
» 20-30 minutes for a hardening temperature of 1070 °C to 1100°C (1958 °F to 2012 °F)
» 10 minutes for hardening temperature 1120 °C (2048 °F)
» After hardening, temper as necessary to the desired hardness, see tempering chart.

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
» Cooling to room temperature after each tempering step is recommended.
» Three tempering cycles between 530 °C and 570 °C (986 °F and 1058 °F) are recommended.
» Refer to the tempering chart for typical values of hardness achievable after tempering. Additional stress relieving after tempering, e.g. after hard machining, can be carried out at a temperature 30 °C - 50 °C (86 °F - 122 °F) lower than the highest tempering temperature in order to minimize hardness decay.



Tempering chart

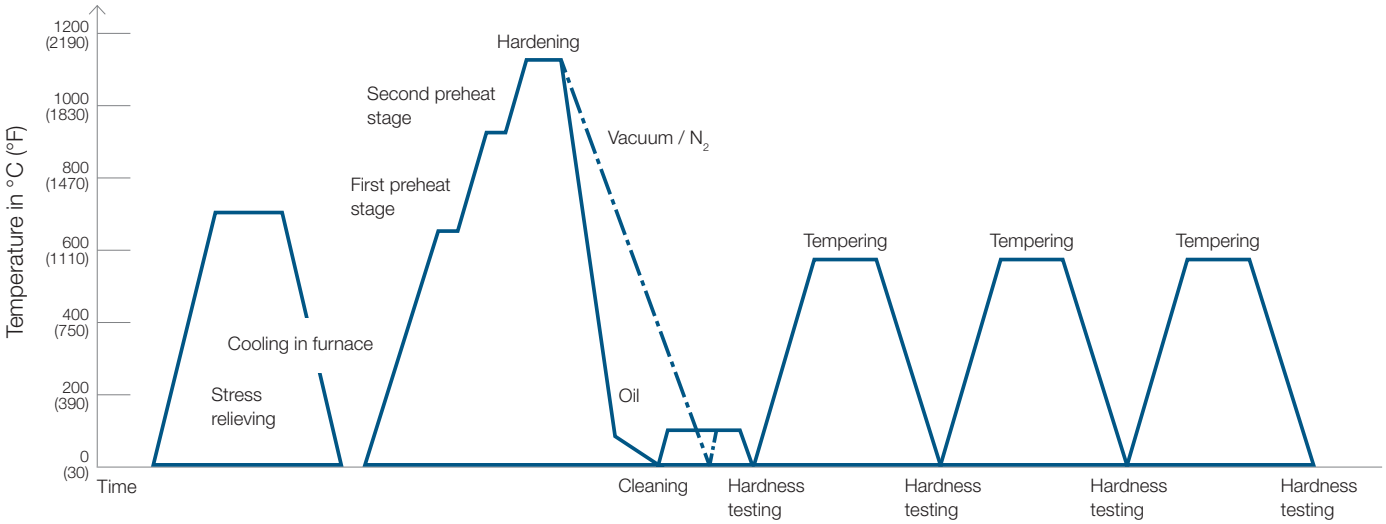


HEAT TREATMENT RECOMMENDATIONS

BÖHLER K888 MATRIX is also characterized by its flexibility in heat treatment:

» Heat treatment with common cold work tool steels and high speed steels is also possible due to the common hardening temperature of 1070 °C to 1120 °C (1958 °F to 2048 °F).

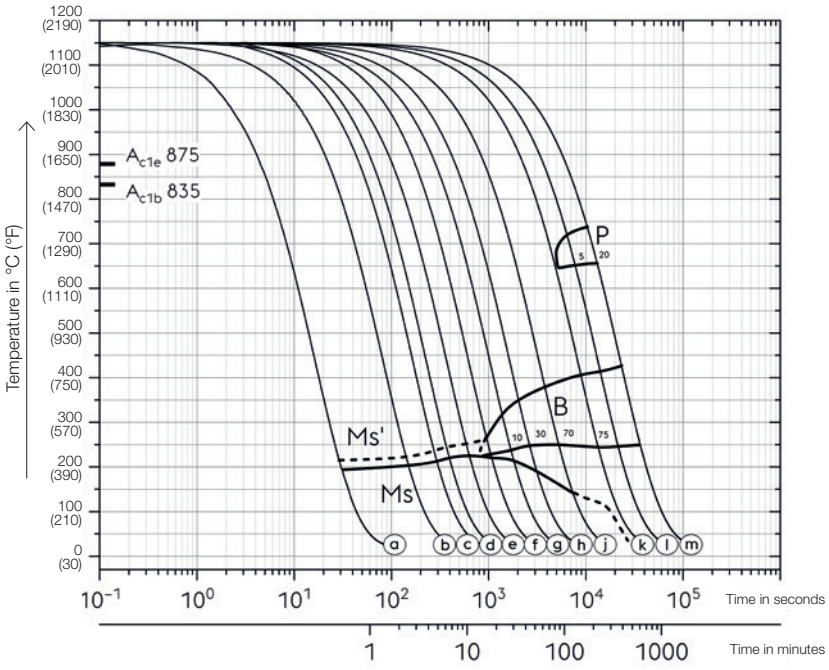
Heat treatment sequence



CCT chart for continuous quenching

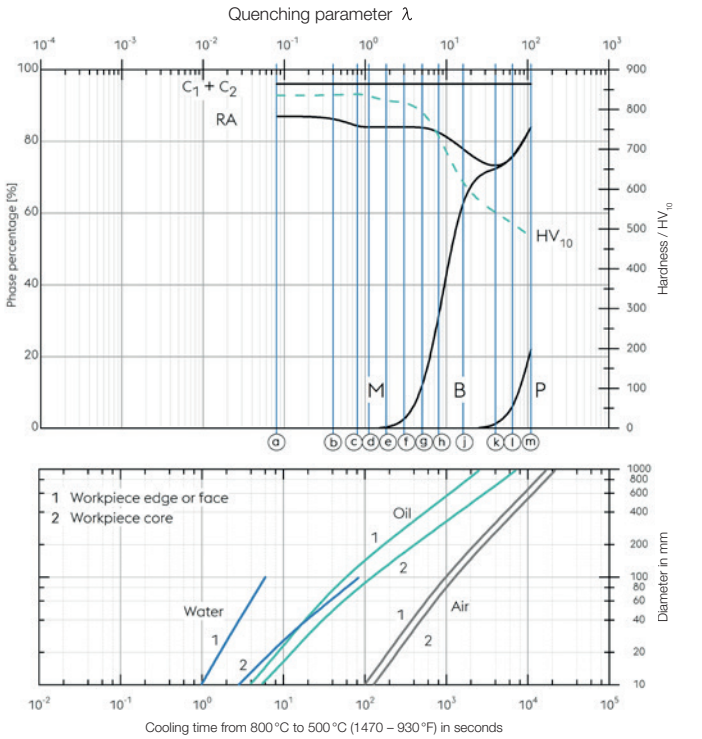
Austenitization temperature:
1150 °C (2102 °F)
Soak time: 180 seconds
5 – 75 Phase proportion in %
0.08 – 110 Quenching parameter λ, (quenching time from 800 °C to 500 °C (1470 °F – 930 °F) in s x 10^{-2}

Specimen	λ	HV10
a	0.08	835
b	0.40	835
c	0.80	840
d	1.10	835
e	1.80	820
f	3.00	820
g	5.00	800
h	8.00	740
j	16.00	600
k	40.00	540
l	65.00	515
m	110.00	480



Microstructure content diagram

C1 Carbide content not dissolved during austenitization
C2 Start of carbide precipitation during quenching from the austenitization temperature
RA Retained austenite
A Austenite
M Martensite
P Perlite
B Bainite



CUTTING PARAMETER BÖHLER K888 MATRIX @ 63HRC

The existing cutting information was evaluated with a demonstrator by company **Hufschmied**.

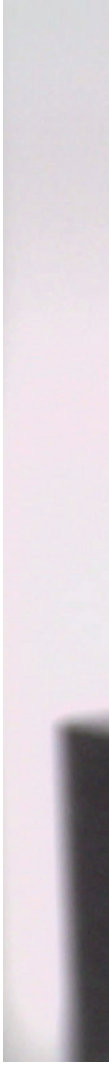
Kind of cutting	Tool company Hufschmied	dm [mm]	z	n [1/min]	vf [mm/min]	vc [m/min]
Rough machining	HHF746100-300-GLX	10	6	1270	2250	40
Rough machining	HC645080-25015	8	5	4200	2000	106
Face milling	HC645080-25015	8	5	3225	870	82
Pre-finishing	HC632040-160	4	2	8000	800	101
Finishing	HC632040-160	4	2	8000	800	101
Coving	HC632040-160	4	2	9500	670	120
Rough machining rest	HC644060-11002	6	4	5300	1100	100
Finishing 5 axis	HC644060-11002	6	4	3180	670	60
Face milling side	HC644060-11002	6	4	4300	900	82
Rough machining four-way	HC643MUT020-060	2	3	16000	1900	101
Slot milling four-way	HC633MUT012-060	1.2	3	23000	1200	87
Finishing four-way	HC633MUT012-060	1.2	3	23000	1200	87
Finishing septum	HC643MUT010-050	1	3	24000	1580	76
Finishing bottom	HC643MUT010-050	1	3	24000	1580	76

ae [mm]	ap [mm]	fz [mm]	Cooling	Milling direction
6.000	0.200	0.30	Air	Synchronization
0.210	7.000	0.10	Air	Synchronization
4.000	0.100	0.05	Air	Synchronization
0.220	0.220	0.05	Air	Synchronization
0.170	0.170	0.05	Air	Synchronization
0.100	0.100	0.04	Air	Synchronization
1.600	0.080	0.05	Air	Synchronization
0.250	2.000	0.05	Air	Synchronization
0.700	0.700	0.05	Air	Synchronization
1.000	0.045	0.04	Air	Synchronization
1.200	0.030	0.02	Air	Synchronization
0.050	0.030	0.02	Air	Synchronization
0.050	0.030	0.02	Air	Synchronization
0.200	0.030	0.02	Air	Synchronization

Legend:

dm	Diameter
z	Number of teeth
n	Spindle speed
vf	Feed rate
vc	Cutting rate
ae	Cutting width
ap	Cutting depth
fz	Feed rate per tooth

Milling machine: Grob G350

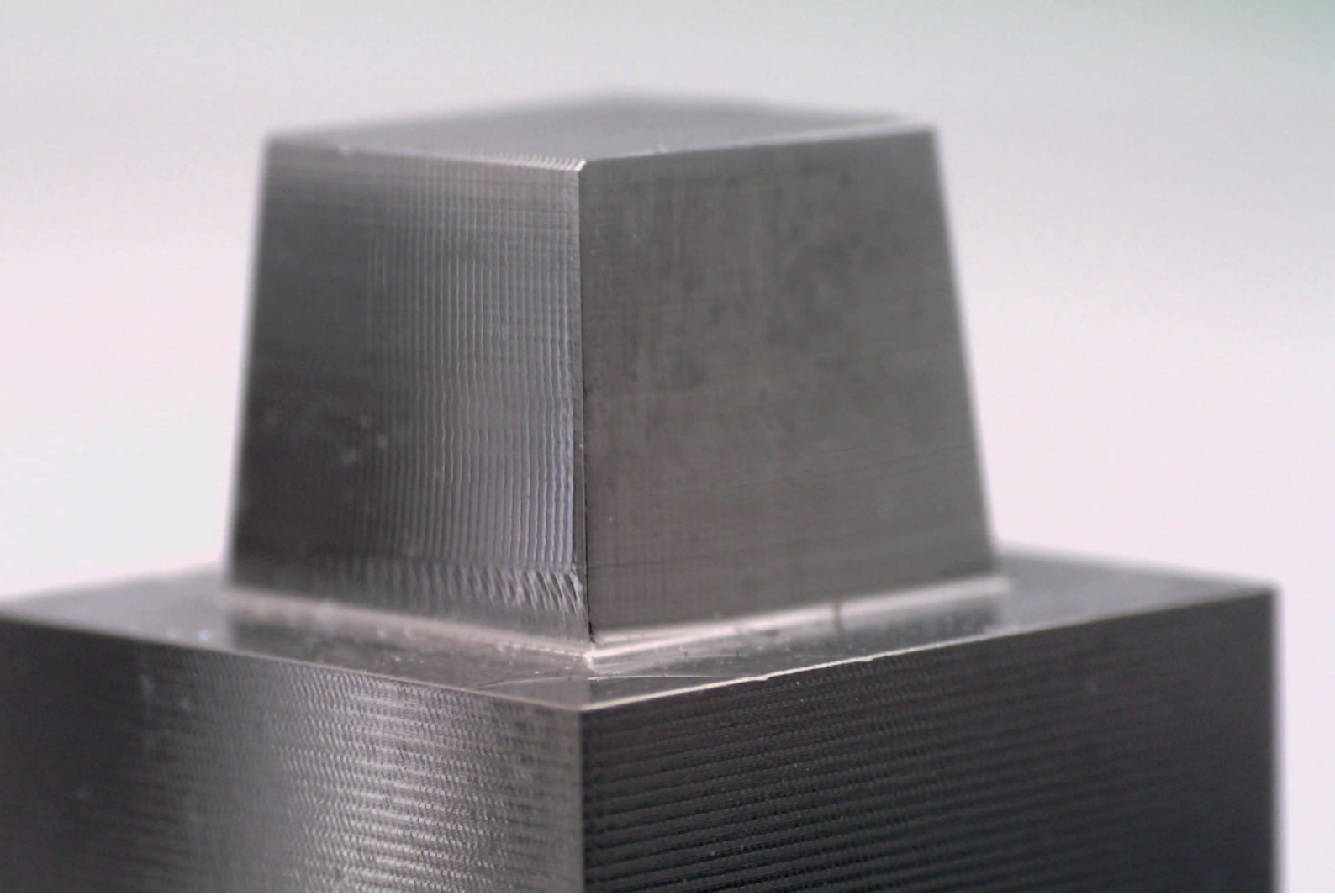


CASE STUDY – CUTTING WITH BÖHLER K888 MATRIX

Results and citation: Hufschmied Zerspanungssysteme GmbH 86399 Bobingen

HUFSCHMIED
ZERSPANUNGSSYSTEME

- Material is easily machinable despite the high hardness of 63 HRC.
- Very good surface finish achievable. Measured surface finish:
  Flat surface Ra<0.15µm
  Contour surface Ra<0.35µm
- Tested tools achieve good tool life and they are not yet at the end of their service life after 3 milled components.



Tool	Tool life at the end of the test	Comments
HHF746100-300	140 min	Existing reserve on tool.
HC645080-25015	150 min	Uniform wear, milled plane surface with TOP- roughness (Ra <0.15µ).
HC632040-160	240 min	Uniform wear, milled surface performs well.
HC644060-11002	25 min	Uniform wear, milled surface performs well.
HC643MUT020-060	30 min	Uniform wear, milled surface performs well.
HC633MUT012-060	70 min	Uniform wear, milled surface performs well.
HC643MUT010-050	45 min	Uniform wear, milled surface performs well.

BÖHLER SPECIAL STEELS FOR THE WORLD'S TOP PERFORMERS

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