



STAINLESS TOOL STEEL

for Plastic-, Food processing-,
Pharmaceutical- and Medical-Industry

BÖHLER M380 
ISOPLAST[®]



INDUSTRIAL BACKGROUND

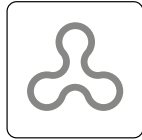
Numerous applications require the use of stainless steel resisting high mechanical stresses, abrasive and corrosive environments. Tools often need a hardness exceeding 55 or even up to 58 HRc. Then the choice of stainless grades becomes limited. A common grade used is 440C (1.4125, BÖHLER N695) with high C content (~1%).

Consequences
of high C content

- » Coarse carbide structure
- » Localized Cr depletion around large carbides
- » High sensitivity to tempering temperature due to carbide precipitations

This leads
to several
limitations

- » Limited corrosion resistance
- » Very limited corrosion resistance at high tempering temperature
- » Limited toughness and fatigue resistance
- » Polishing difficulties (e.g. sensitivity to carbide pull out)



PLASTIC MOLD
STEEL

NEW PRESSURIZED ELECROSLAG REMELTED PLASTIC MOLD STEEL

BÖHLER M380
ISOPLAST®

**Combines highest hardness, toughness
and corrosion resistance with mirror polishability
and good wear resistance**

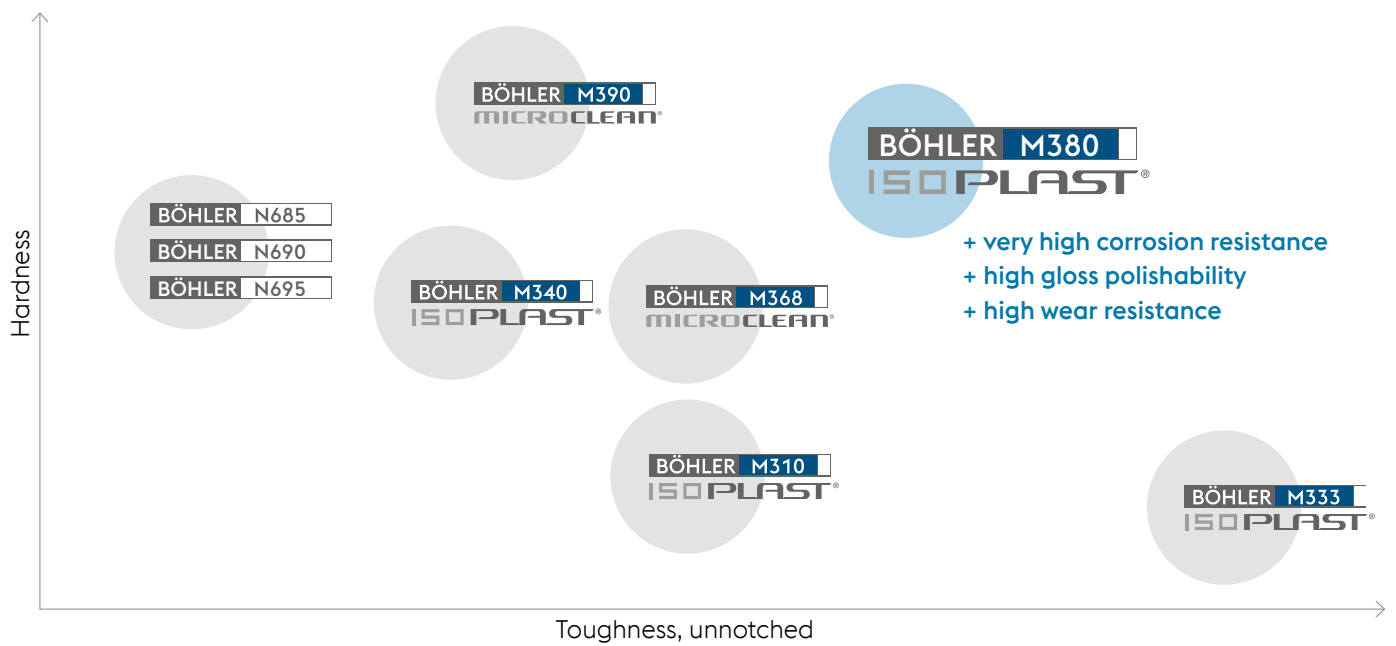
**KEY BENEFITS
FOR OUR CUSTOMERS**

- » Best part quality
- » Longer tool life and less maintenance
- » Lower production costs per part



PESR
Pressure Electro
Slag Remelting

Product positioning





THE SOLUTION **BÖHLER M380** ISOPLAST®

BÖHLER M380 ISOPLAST is a **PRESSURIZED** electroslag remelted **high nitrogen alloyed** martensitic plastic mold steel with an **outstanding corrosion resistance** and **very high toughness** at **high hardness** levels up to 60 HRC.

PESR-remelting allows a high nitrogen content which leads to a homogeneous microstructure with fine distributed carbonitrides and excellent cleanliness.

Main properties

- » Very high hardness / strength and good wear resistance
- » Very high toughness and corrosion resistance
- » Mirror polishability and good machinability
- » High suitability for PVD coating
- » Low distortion and good dimensional stability

Chemical composition

average (%)

BÖHLER M380
ISOPLAST®

(= 1.4108, X30CrMoN 15-1)

C	Si	Mn	Cr	Mo	N
0.30	0.60	0.40	15.0	1.0	0.40

Condition of delivery

Annealed to max. 255 HB

Material properties

Partial substitution of carbon with **nitrogen (PESR, above solubility limit)**

In combination with carbon

- » A hardness of at least **55 up to 60 HRc** can be ensured
- » A microstructure incl. **fine eutectic carbonitrides** is obtained

Nitrogen combined with Cr and Mo leads to an improved **pitting corrosion resistance**.

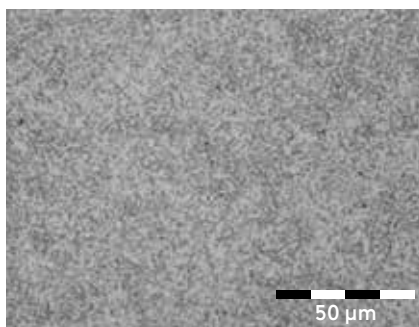
Mo ensures a secondary hardening. Mo replaces Cr in the precipitates and so Cr is kept in the **matrix** at a high level.

This leads to **improved corrosion resistance**, even when tempered at **high temperature**.

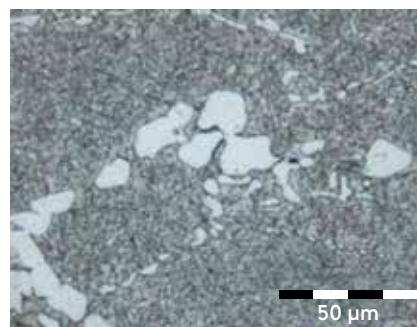
CORROSION RESISTANT TOOL STEELS

BÖHLER Grades					
	Standards (Examples)	Conventional quality	Remelted Steels (ESR, PESR, VMR)	PM-Grades	AM-Powder
>58 HRc	1.4108		BÖHLER M380 ISOPLAST®	BÖHLER M398 MICROCLEAN® BÖHLER M390 MICROCLEAN®	
~54 HRc	1.4125 1.4528 1.4112	BÖHLER N695 BÖHLER N690 BÖHLER N685	BÖHLER M340 ISOPLAST®	BÖHLER M368 MICROCLEAN®	
~50 HRc	1.2083		BÖHLER M333 ISOPLAST® BÖHLER M310 ISOPLAST® BÖHLER M789 VMR®		BÖHLER M789 AMPO
~40 HRc	1.2316 1.4542	BÖHLER M303 EXTRA HIGH HARD	BÖHLER M303 ISOPLAST® HIGH HARD BÖHLER N700		BÖHLER N700 AMPO
~30 HRc	1.2316 1.2085	BÖHLER M303 EXTRA BÖHLER M315 EXTRA BÖHLER M314 EXTRA	BÖHLER M303 ISOPLAST®		

Comparison of microstructure



Microstructure **BÖHLER M380 ISOPLAST**
Microstructure incl. **fine eutectic carbonitrides** is obtained



Microstructure 440C, 1.4125

HEAT TREATMENT

Tempering curves / Vacuum heat treatment with subzero cooling

Heat treatment in vacuum furnace

Austenitizing at 1020°C/1050°C

(1868°F/1922°F)/20min/5bar

Subzero cooling highly recommended

-80 °C/2 hrs

Tempering 2x2h

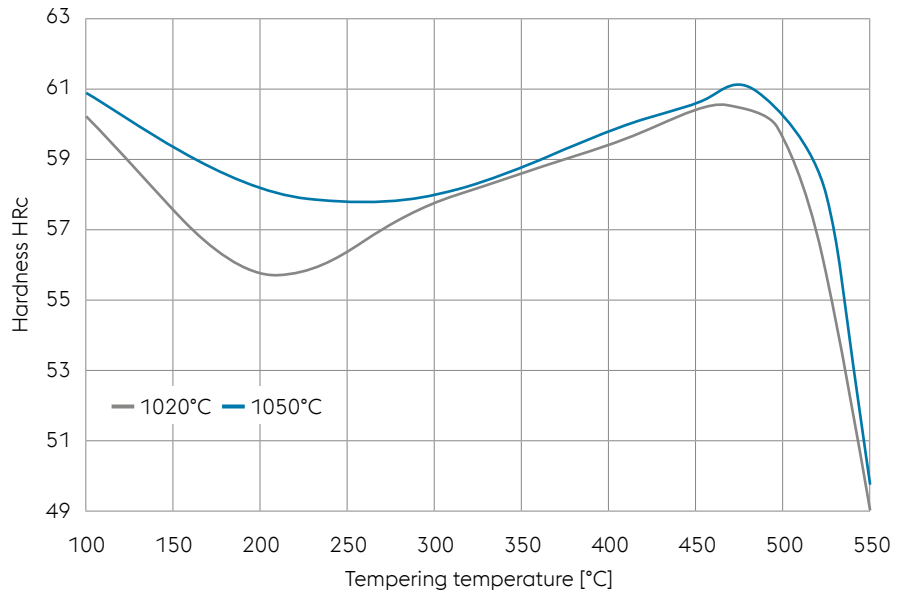
Heat treatment recommendation

1.030 °C/-80 °C/2 x 250-350°C

for best corrosion resistance and toughness;
goal hardness 56 – 58 HRC

1.030 °C/-80 °C/2 x 495-525°C

for balanced wear resistance,
hardness & toughness;
goal hardness 58 – 60 HRC



Continuous cooling CCT curves

Austenitizing temperature: 1030° C

Holding time: 30 minutes

A Austenite

K Carbide

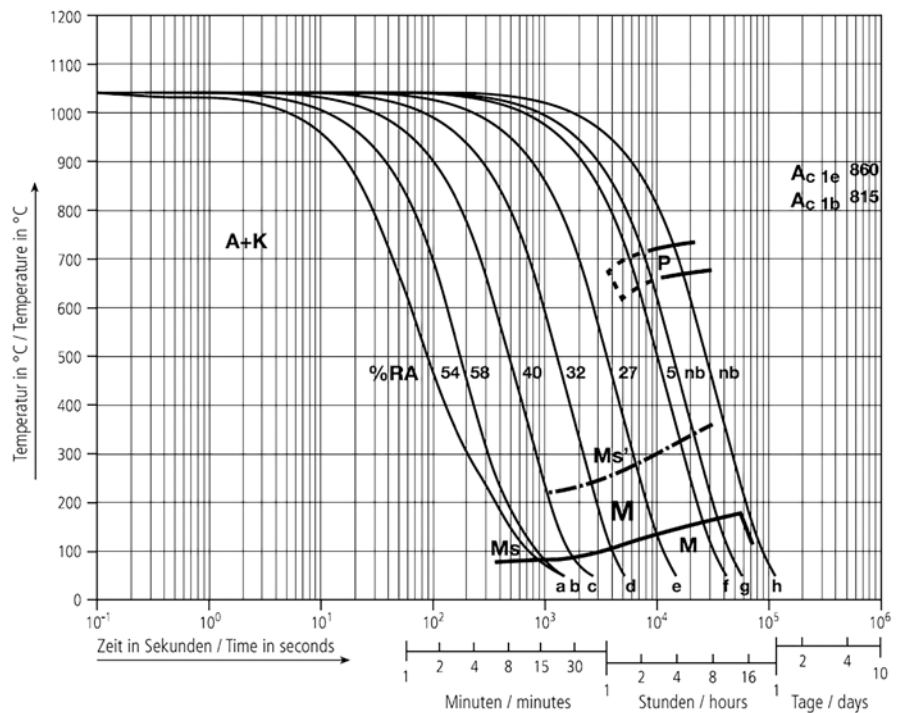
M Martensite

P Pearlite

RA Retained austenite

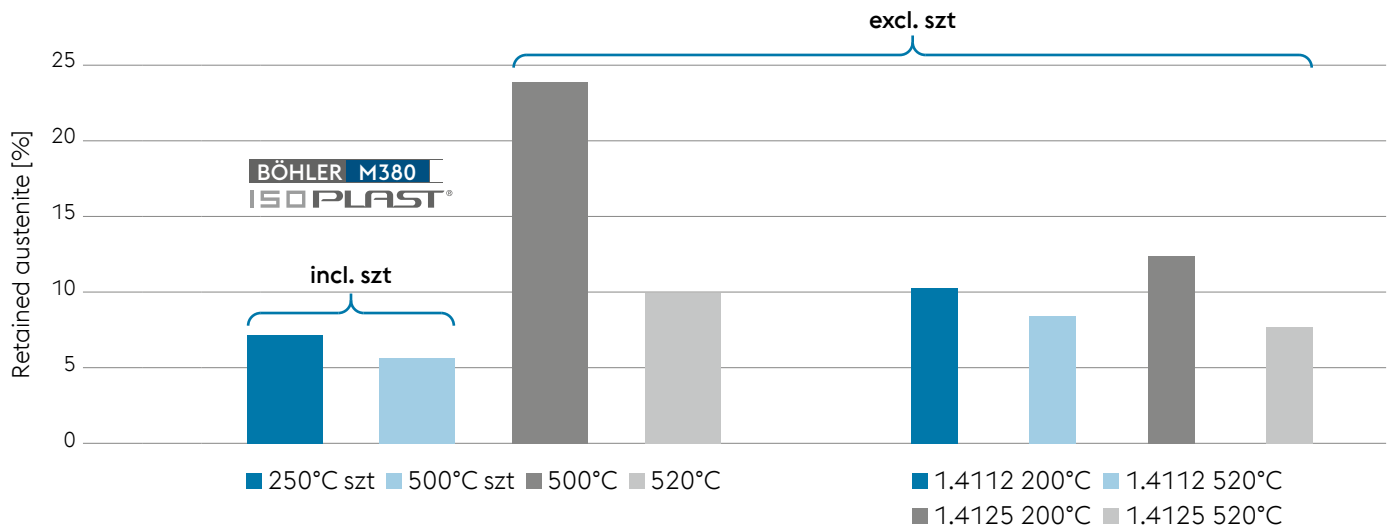
Ms'-Ms Range of grain boundary martensite formation

Sample	λ	HV ₁₀
a	0.5	511
b	1.1	472
c	3.0	529
d	8.0	568
e	23.0	570
f	65.0	589
g	90.0	575
h	180.0	237



MATERIAL PROPERTIES

Retained austenite



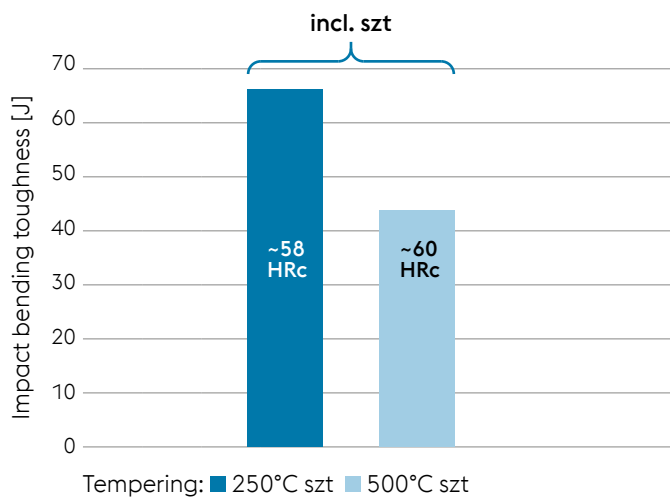
Heat treatment

Austenitizing at 1030°C (1886 °F)/20min/5bar, without/with subzero treatment (szt);

Tempering 2x2h

Low amounts of retained austenite compared to 440C, 1.4125 after heat treatment incl. sub zero to ensure a high dimensional stability of the tools

Toughness



Heat treatment

Austenitizing at 1030°C (1886°F)/30min/5.5bar, with subzero treatment

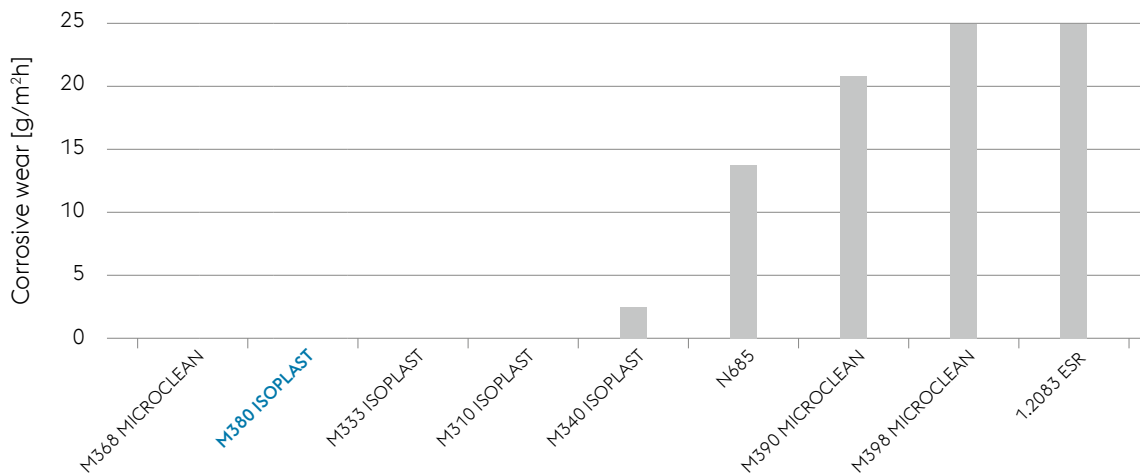
Tempering 2x2h

Tested sizes:

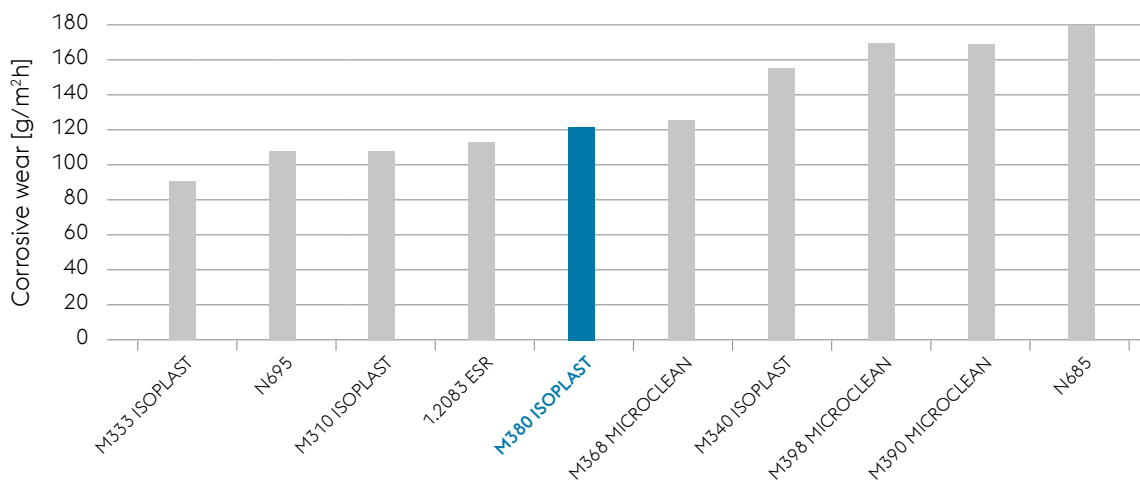
BÖHLER M380 ISOPLAST, flat 218x218mm (8.6x8.6 inches)

High impact- and fracture toughness combined with high hardness, typically 59 HRC

Corrosion resistance / low tempered



Corrosion resistance / high tempered



Heat treatment for BÖHLER M380 ISOPLAST

Austenitizing at 1020°C (1868 °F)/20min/5bar, without subzero treatment;

Tempering 2x2h

Weight loss test: Measured after 24h in 20% boiling acetic acid

Content of N and Mo leads to very high corrosion-resistance, also if tempered at high temperature

MATERIAL PROPERTIES

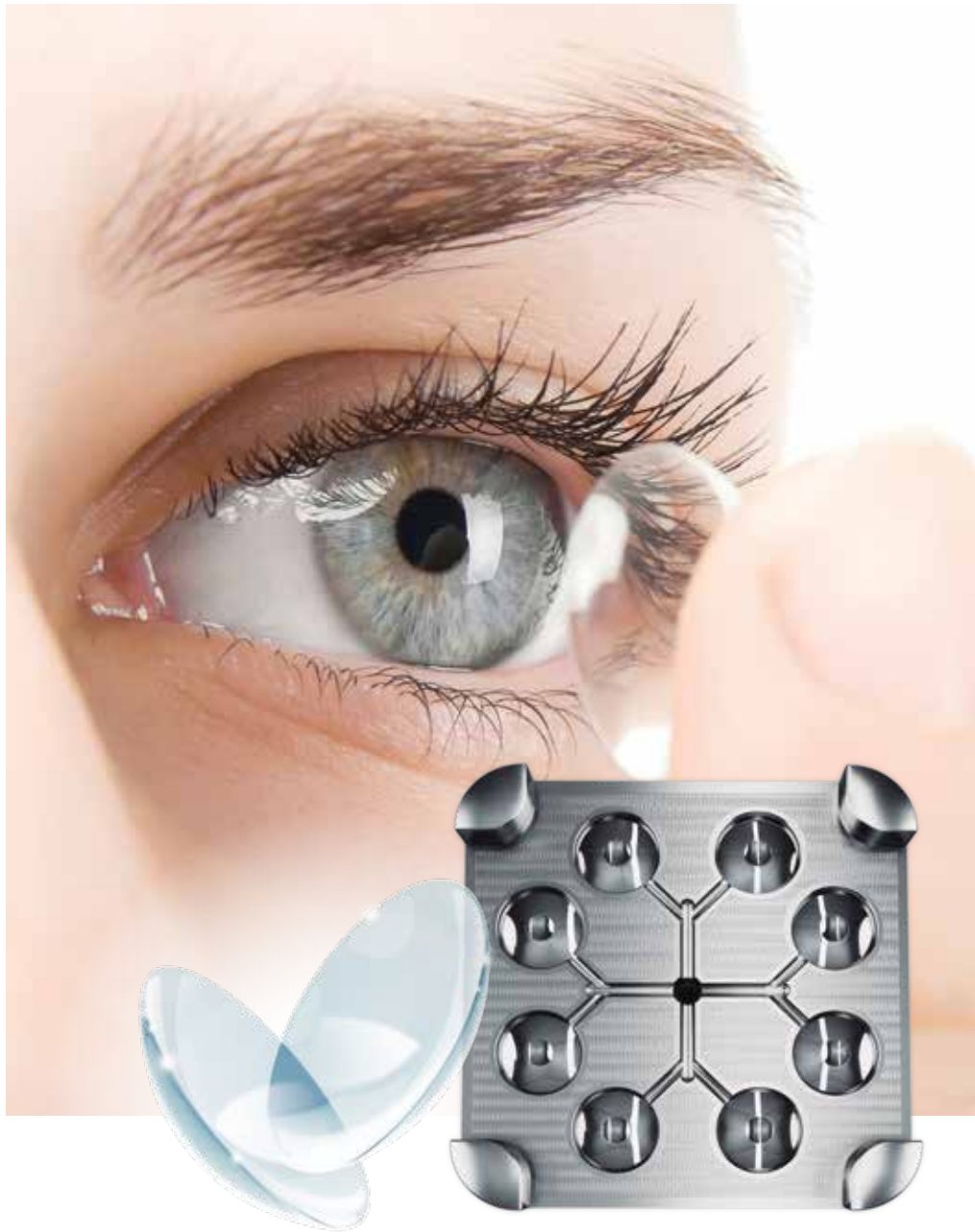


POLISHING

BÖHLER grade	Polishability
BÖHLER M310 ISOPLAST®	★ ★ ★
BÖHLER M333 ISOPLAST®	★ ★ ★ ★ ★
BÖHLER M340 ISOPLAST®	★ ★
BÖHLER M368 MICROCLEAN®	★ ★ ★ ★ ★
BÖHLER M380 ISOPLAST®	★ ★ ★ ★ ★ ★
BÖHLER M390 MICROCLEAN®	★ ★ ★
BÖHLER N685	★

The special remelting technology (PESR) allows remelting in a closed vessel in a nitrogen atmosphere, which excludes oxygen. Thus an increase in degree of oxide purity level is achieved and, as a result, improved corrosion resistance, polishability, photo etching and spark eroding of the steel is realized. Due to lowest amount of primary carbides, high hardness and high homogeneity BÖHLER M380 ISOPLAST has excellent polishability properties.

This collection of positive attributes guarantees cost savings by considerably reducing polishing efforts to a mirror finish.



The comparison of BÖHLER grades in the left chart illustrates the effort reaching a mirror-polished surface with $Ra = 0.04 \mu\text{m}$ starting from a pre-ground surface.

Polishing steps



APPLICATIONS

» **Plastic injection molds**

for long run production like medical disposal syringes, ...

» **Plastic injection molds for GF-filled plastics**

like automotive-, household- and electronic industry

» **High gloss surface finish molds**

for production of optical parts like camera lenses, transparent and decorative parts

» **Screws and non return valves**

for injection molding machines

» **Hot runner gate parts**



FOOD AND BEVERAGE

Certificate and Declaration of Conformity acc. EU-regulation No. 1935 (aqueous and acid) for M380 ISOPLAST is available

» **Screws for extrusion machines**

for processing of food

» **Cutting type instruments and knives**

» **Can closing rolls**

» **Punches & dies for powder compacting**

of sweets and pharmaceutical products

» **Components**

like portion and filling units and adaptive chucks for caps (closure system machines)

■ **M380 ISOPLAST is not allowed to be used**
● **for aviation and automotive components like bearings, ball screws,**
● **wear resistant parts for use in aircrafts.**



Food approval

- » **BÖHLER M380 ISOPLAST (BÖHLER N360 PESR) has got food approval acc. European Regulation (EC) No. 1935**
- » Therefore it is intended to get in contact with food aswell for **aqueous as acidic** applications.
- » Tests performed in **low tempered condition**.
- » BÖHLER M380 ISOPLAST hardened at 1020°C, sub zero -80°C, tempered at 200°C (twice for 2h)

MACHINING GUIDELINES

Turning with carbide	annealed condition			
	finishing	semi finishing	roughing	
Cutting depth mm	0.5 - 2	1 - 4	4 - 8	above 8
Feed mm/U	0.1 - 0.3	0.2 - 0.4	0.3 - 0.8	0.5 - 1.5
Cutting speed m/min	130 - 260	100 - 220	80 - 140	30 - 90
Recommended Boehlerit Geometry	FP, FMP	MP, MRP	MRP	RP, BR, BRP
Boehlerit - carbide grade	LCP15T	LCP15T, LCP25T	LCP25T, LC240F	LC240F
ISO - Variety	P15	P15, P20	P20, P30	P30, P40

Milling with carbide	annealed condition		
	finishing	semi finishing	roughing
Cutting speed m/min	160 - 230	150 - 200	120 - 170
Boehlerite - carbide grade	BCH10M, BCP25M	BCH30M, BCP30M	BCH30M, BCP35M
ISO - Variety	H10, P25	H30, P30	H30, P35
Fz corner milling 90° (mm)	0.1 - 0.3	0.1 - 0.3	0.1 - 0.3
Fz plan milling 45° (mm)	0.15 - 0.4	0.15 - 0.6	0.15 - 0.6
Fz High feed machining (mm)	0.8 - 2.5	0.8 - 2.5	0.6 - 3.0

Turning with carbide	Hardened to 58-60 HRC	
	finishing	semi finishing
Cutting depth mm	0.5 - 1	0.5 - 1
Feed mm/U	0.1 - 0.2	0.1 - 0.2
Cutting speed m/min	40 - 60	35 - 50
Recommended Boehlerit Geometry	FMS	MT
Boehlerit - carbide grade	LC415Z	BCS20T
ISO - Variety	S15/H15	S20/H20

Milling with carbide	Hardened to 58-60 HRC		
	finishing	semi finishing	roughing
Cutting speed m/min	150 - 200	120 - 170	90 - 140
Boehlerite - carbide grade	BCP20M, BCH10M	BCP20M, BCH30M	BCP25M, BCP30M
ISO - Variety	P20, H10	P20, H30	P25, P30
Fz corner milling 90° (mm)	0.1 - 0.2	0.1 - 0.25	0.1 - 0.3
Fz plan milling 45° (mm)	0.15 - 0.4	0.15 - 0.5	0.15 - 0.5
Fz High feed machining (mm)	1.0 - 2.0	1.0 - 2.5	0.6 - 3.0



NUMBERS, FIGURES AND FACTS

Physical properties at 20°C/68°F

Density	7.72 kg/dm ³
Thermal conductivity	14 W/(m.K)
Specific heat	430 J/(kg.K)
Electrical resistivity	0.8 Ohm.mm ² /m
Modulus of elasticity	223 x 10 ³ N/mm ²
Magnetic properties	magnetic

Thermal expansion

between 20 °C and ... °C, 10 ⁻⁶ m/(m.K)				
100 °C	200 °C	300 °C	400 °C	500 °C
10.4	10.8	11.2	11.6	11.9

Modulus of elasticity

10 ³ N/mm ²				
20 °C	100 °C	200 °C	300 °C	400 °C
223	217	209	201	192

As regards applications and processing steps that are not expressly mentioned in this product description/data sheet, the customer shall in each individual case be required to consult us.

The data contained in this brochure is merely for general information and therefore shall not be binding on the company. We may be bound only through a contract explicitly stipulating such data as binding. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.

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ONE STEP AHEAD.