



YOUR PARTNER FOR
HIGH SPEED STEELS, TOOL STEELS
AND SPECIAL MATERIALS

FOR THE WORLD'S
TOP PERFORMERS



METALLURGICAL KNOW-HOW SINCE 1870.



EMIL BÖHLER



ALBERT BÖHLER



For generations worldwide customers appreciate the highest steel quality from **BÖHLER**.

We produce **SPECIAL STEEL FOR THE WORLD'S TOP PERFORMERS** and our standard is to provide the best solution every time – whether in manufacturing technology, materials development, or customer service.

With an international sales and service network we are always close to our customers – worldwide.

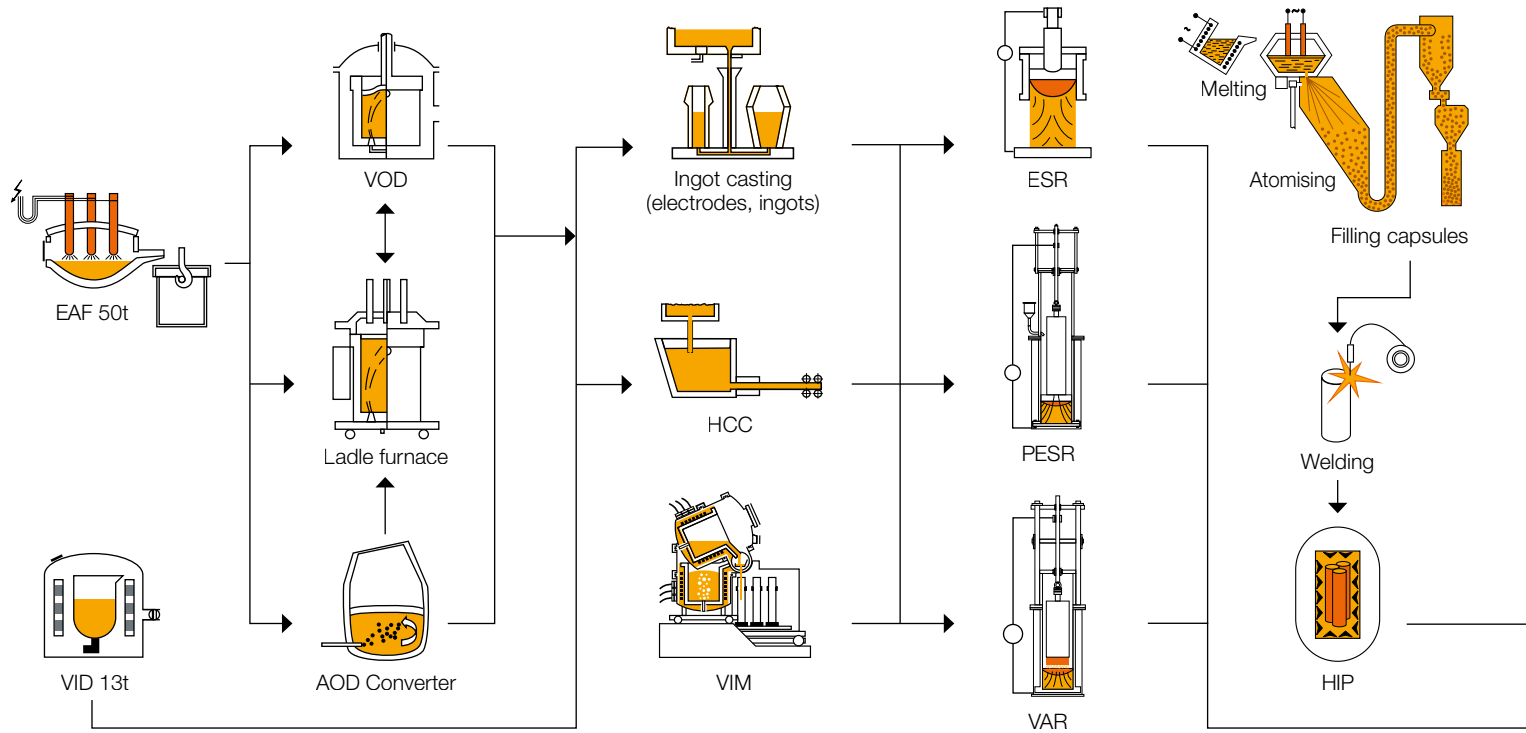
WELCOME TO BÖHLER.



It is impossible to imagine our modern world without special steel. This material will continue to drive success and growth in crucial branches of industry, both in direct components and in the tools used to shape them.

FOR THE WORLD'S BEST STEEL GRADES

Flow of material



Melting

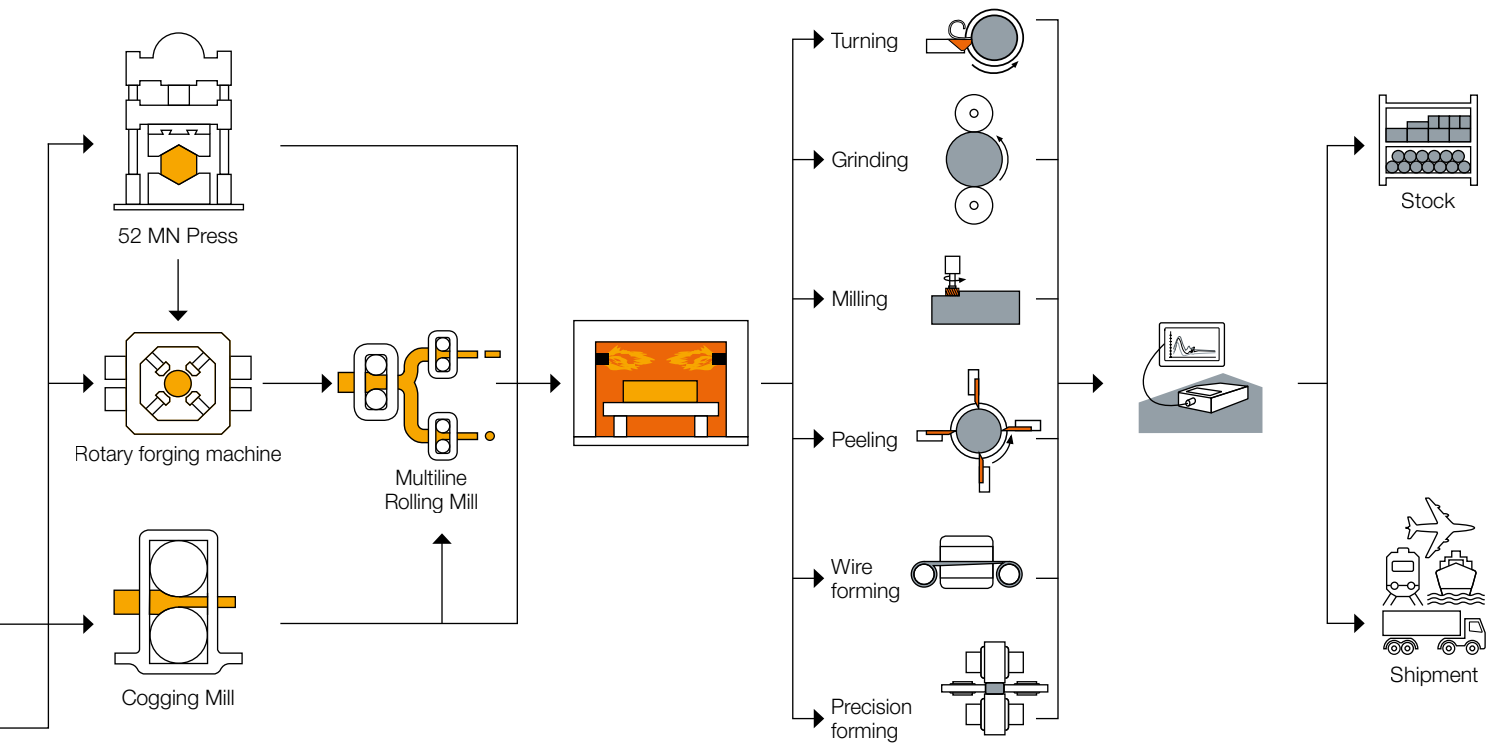
Secondary metallurgy

Casting / Melting

Remelting

Powder metallurgy





Rolling and Forging

Heat Treatment

Machining

Testing

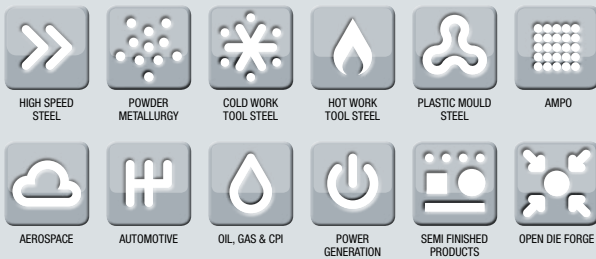
Dispatch



BÖHLER SPECIALTIES

What do we stand for?

We develop, produce and deliver high speed steels, tool steels and special materials worldwide, to provide our customers with customized solutions.



MICROCLEAN®

Powder metallurgical steels

VMR®

Special materials subjected to vacuum refining or melting during at least one stage of manufacture.

ISO PLAST®

Plastic mould steels in ESR quality

ISO DUR®

Cold work tool steels in ESR quality

ISO RAPID®

High speed steels in ESR quality

ISO BLOC®

Hot work tool steels in ESR quality with special heat treatment

ISO DISC®

Hot work tool steels in conventional quality with special heat treatment

EXTRA

Special property and/or achievement characteristics

BÖHLER BHT

Bars hardened and tempered

AMPO

Additive Manufacturing Powder

PRODUCT RANGE

Materials

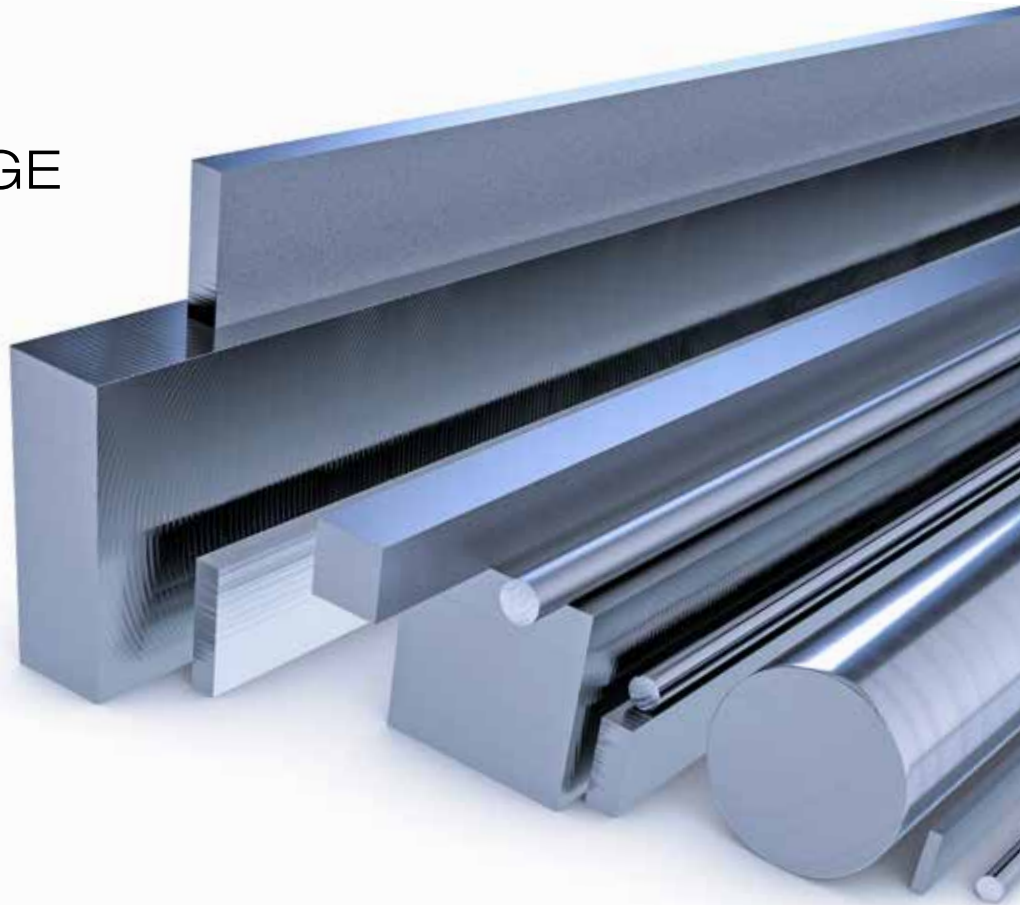
High speed steels

Tool steels

- Cold work tool steels
- Hot work tool steels
- Plastic mould steels

Special materials

- Special constructional steels
- Stainless steels
- Creep resisting steels
- Heat resisting steels
- Valve steels
- Steels with special physical properties
- Steels for particular applications
- Ni base alloys



Products

BAR STEEL rolled

round:		12.5 – 150 mm
square:		15 – 150 mm
flat:	width	thickness
	15 – 60 mm	5 – 41 mm
	60 – 200 mm	5 – 86 mm
	100 – 300 mm	15 – 80 mm

ROLLED WIRE

rolled (dia.)	5.0 – 13.5 mm
drawn (wire, bar steel):	0.6 – 13.3 mm Ø
round (bar steel):	2.0 – 28.0 mm Ø
peeled (wire):	4.5 – 13.0 mm Ø
BHT (hardened and tempered) bar steel:	3.0 – 20.0 mm Ø
flat or profiled wire:	0.5 – 40.0 mm ²

BAR STEEL forged

round:	101 – 1150 mm	
square:	110 – 1150 mm	
flat:	width	thickness
	107	70 mm minimum
	1600	1150 mm maximum

Ratio width/thickness maximum 10:1

BAR STEEL pre-machined

IBO ECOMAX 12.5 – 315 mm
(on request up to 900 mm)

BRIGHT STEEL

BRIGHT STEEL ground and polished
ECOBANK peeled and polished
ECOFINISH band ground

Surface finish

black (abrasive blasted); pickled; machined (turned, peeled, polished h12 – h9); ground – polished

Forgings

Open-die forgings of a gross weight of up to 45t: unmachined, pre-machined, machined ready for mounting. Machining of rolled, forged and cast components on state-of-the-art machines.

Industries

Automotive industry, aviation industry, turbine construction, toolmaking industry, general mechanical engineering, offshore industry, energy engineering, medical technology

COLD WORK TOOL STEELS

3 QUALITY LEVELS – 3 TECHNOLOGIES



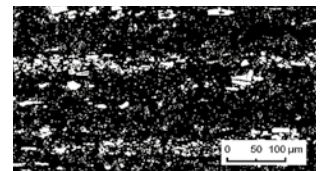
COLD WORK
TOOL STEEL

Conventional Manufacture



Ingot casted cold work tool steel

The conventional steel quality for standard tooling applications.



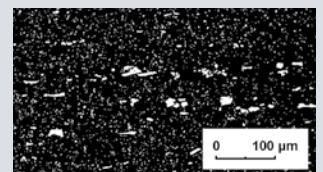
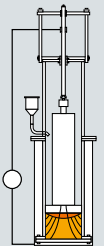
Microstructure of conventional 12% Cr steel

ESR / PESR Manufacture



Improved service life due to:

- Least possible inclusion content
- Lower micro and macro segregation
- Good homogeneity and a higher degree of purity
- Homogeneous structure throughout the entire cross-section and bar length
- Producing larger bar dimensions at a constant carbide distribution
- Uniform size change
- Broad range of application owing to a high degree of toughness



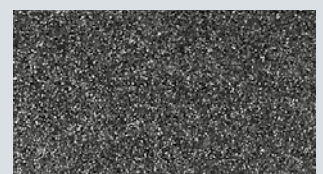
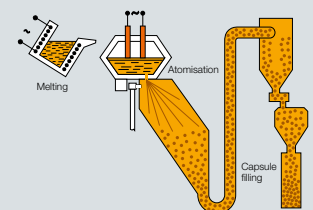
Microstructure of an 8% Cr steel in ESR quality

Powder Metallurgical Manufacture

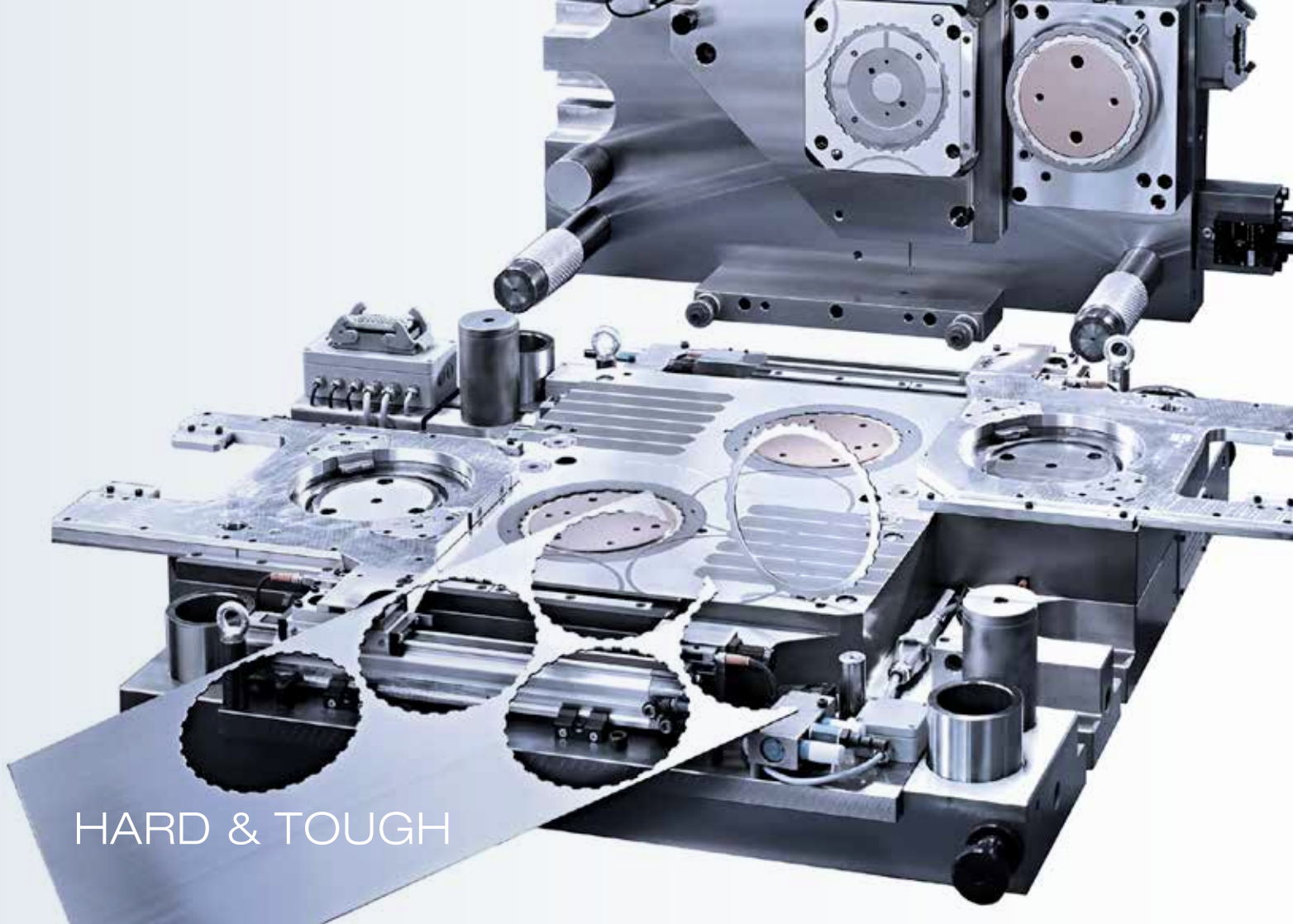


For the highest demands:

- Finest carbide distribution
- Highest metallurgical purity
- Segregation free high performance steel
- Isotropic properties
- Maximum wear resistance with a simultaneously higher toughness
- High degree of hardness
- Very good dimensional stability
- High compressive strength
- Good polishability



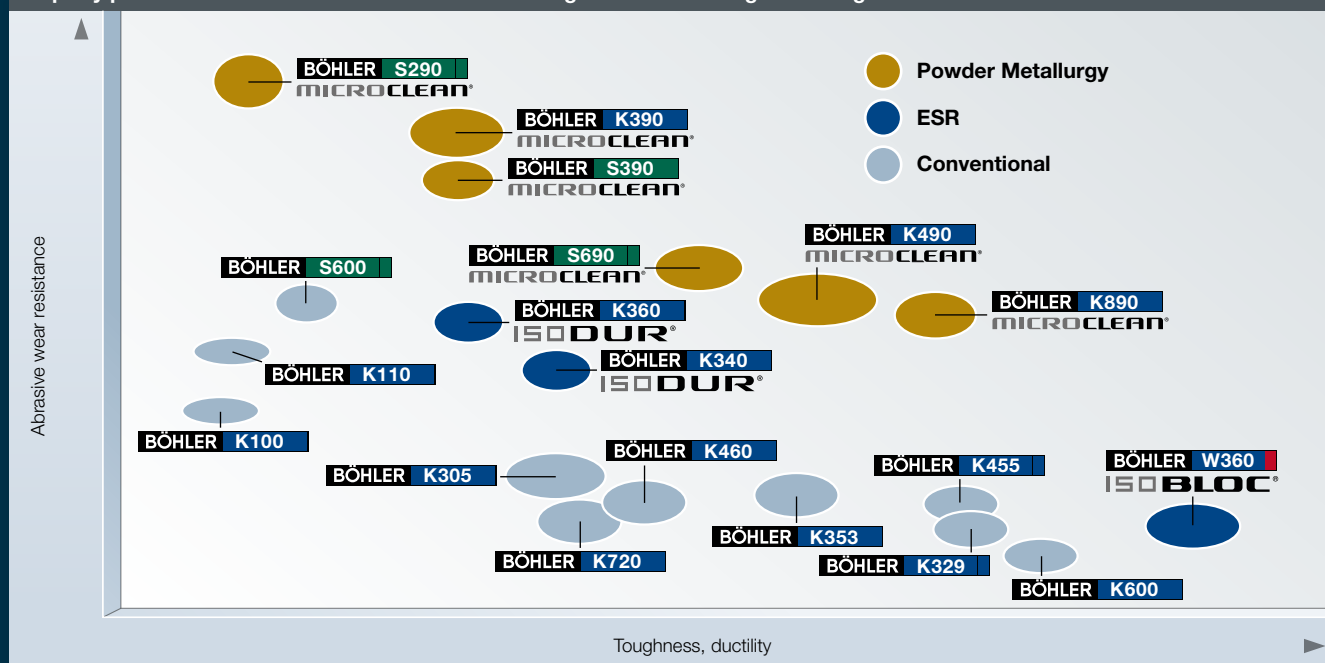
MICROCLEAN®
Microstructure PM materials



HARD & TOUGH

The reason for using quality tool materials is obvious, as the material amount of a high performance tool is often only 5% of the total value of a tool, yet it **extends the lifetime of tools many times**. In a word, it's a direct commercial advantage in production.

Property profile of BÖHLER cold work steels according to manufacturing technologies



BÖHLER K340 ISODUR®



BÖHLER K340 ISODUR is a universal cold work tool steel with which you'll be making money – and not just when blanking coins, but also when **blanking, cutting, cold rolling, extruding, deep drawing, bending.**

In applications where materials with good wear resistance and compressive strength coupled with excellent toughness are required, BÖHLER K340 ISODUR has proved itself to be the all-rounder among tool steels.

Advantages compared to ledeburitic 12% Cr-steels and conventional 8% Cr-steels

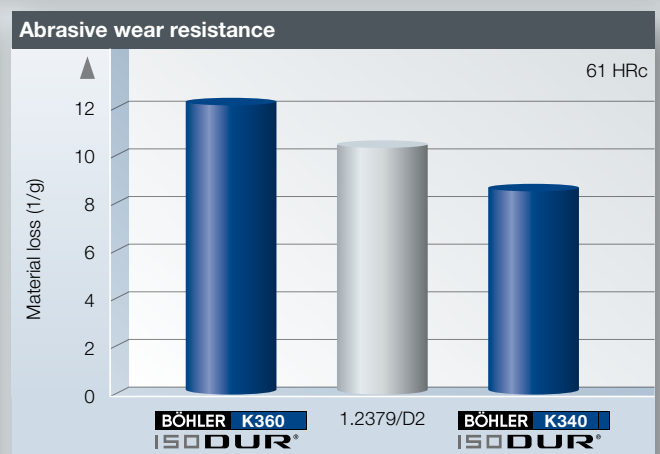
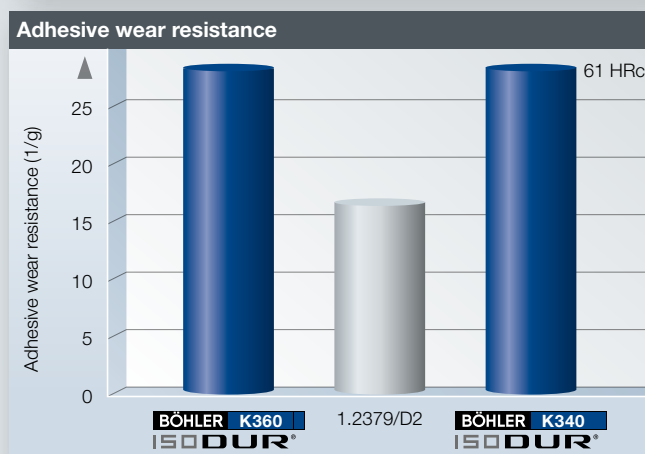
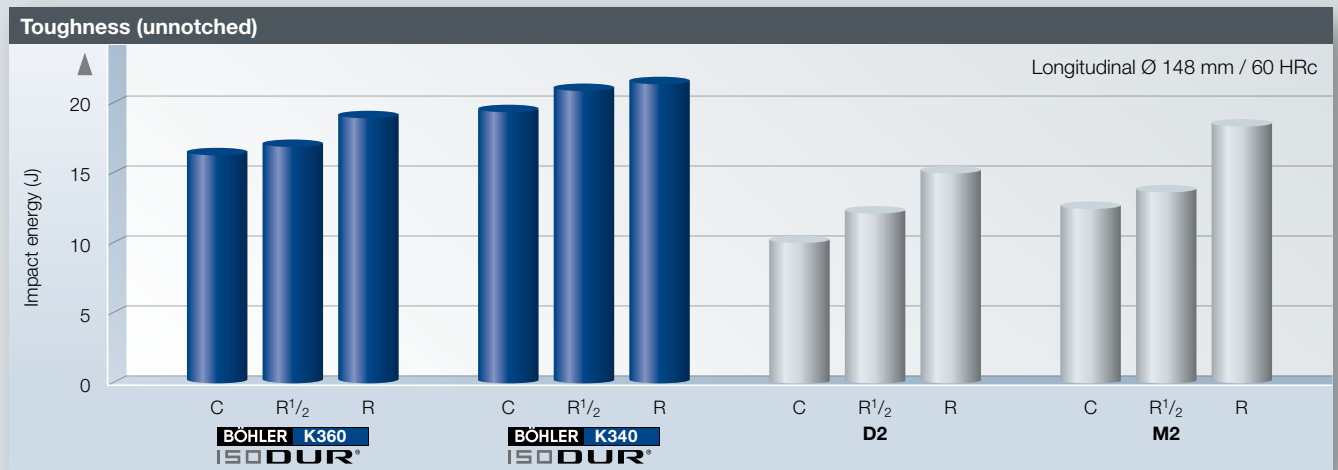
- Homogeneous structure throughout the entire cross-section and length
- Production of bars with greater diameters and a good distribution of carbides
- Uniform, solely minor dimensional changes
- High toughness providing a wider scope of application
- Increased compressive strength, a particular advantage for critical tools
- Improved machinability due to the homogeneous structure

Reasons why BÖHLER K340 ISODUR is so cost-efficient

- 8% Cr-steel with a modified chemical composition
- High toughness and outstanding compressive strength
- Excellent adhesive wear resistance thanks to special alloy additions
- High abrasive wear resistance
- Very good resistance to tempering
- Secondary-hardening cold work tool steel with good dimensional stability
- Outstanding EDM machinability
- Very well suited to salt-bath, gas and plasma nitriding
- Can be PVD coated well
- Well suited to vacuum hardening
- Thanks to the chemical composition and the manufacturing process, this steel has finer and more evenly distributed carbides than ledeburitic 12% Cr-steels (AISI D2) and conventional 8% Cr-steels. This gives the steel its improved toughness properties.

Application fields

Forming and punching tools e.g. dies and punches, cold working tools e.g. tools for deep drawing or extrusion, coining tools, bending tools, thread rolling tools, industrial knives, machine components (e.g. guide rails)



BÖHLER K490 MICROCLEAN®



Innovation

BÖHLER's new cold work tool steel K490 MICROCLEAN closes the gap in the material demands between wear resistance and the desired toughness on a very high level.

Flexibility

A further advantage of this powder metallurgical cold work tool steel, being produced in a plant of the newest generation, lies in the good machinability and the high flexibility of its heat treatment, which allows variable heat treatment cycles without affecting the mechanical properties.

Cost-Efficiency

These excellent properties guarantee a risk-free, more flexible and faster – that is economically efficient – tool manufacture.

Versatility

BÖHLER K490 MICROCLEAN is a greatly improved and more efficient cold work tool steel compared with other commonly used PM steels such as M4 or PM23. **Toughness is more than doubled** with a similar wear resistance.

BÖHLER K490 MICROCLEAN's balanced properties can be made use of in a wide range of applications, making it a real PM all-rounder for cold work tool steel applications.

Blanking and punching industry

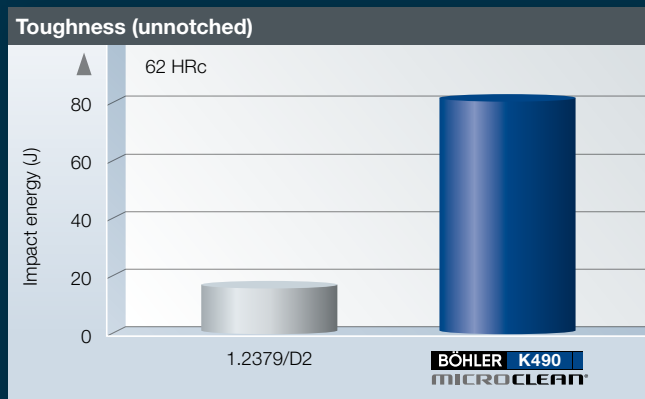
- Cutting tools (dies, punches) for normal and precision blanking
- Cutting rolls

Cold forming applications

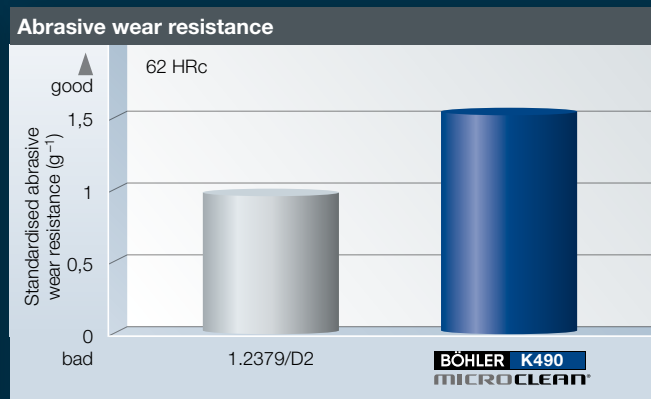
- Extrusion tooling (cold and warm forming)
- Drawing and deep-drawing tools
- Stamping tools
- Thread rolling tools
- Cold rolls for multiple roller stands
- Cold pilger rolling mandrels
- Compression moulding dies for the ceramics and pharmaceutical industries
- Compression moulding dies for the processing of sintered parts

Industrial knives

- Plastic processing industry



Samples taken from a rolled steel bar in longitudinal direction, heat treated at a cooling rate of: $\lambda \leq 0,5$
 Primary material size: rund / round 35 mm
 Sample size: 10 x 7 x 55 mm
 Heat treatment parameters for:
 BÖHLER K490 MICROCLEAN: 1080 °C, 3 x 2 h, 560 °C
 1.2379/D2: 1070 °C, 3 x 2 h, 520 °C



Determined by the Rubber-Wheel-Dry-Sand test according to ASTM G65
 Samples taken from a of rolled steel bar in lateral direction, center
 Primary material size: rund / round 70 mm
 Sample size: 60 x 25 x 8 mm, Ra < 0,8 µm
 Heat treatment parameters for:
 BÖHLER K490 MICROCLEAN: 1080 °C, 3 x 2 h, 560 °C
 1.2379/D2: 1070 °C, 3 x 2 h, 510 °C

Saves time and money

Speed is vital in component manufacture. Process time from prototype to finished tooling is drastically reduced. Tools of complicated design and high quality can be produced quickly and efficiently.

Benefits

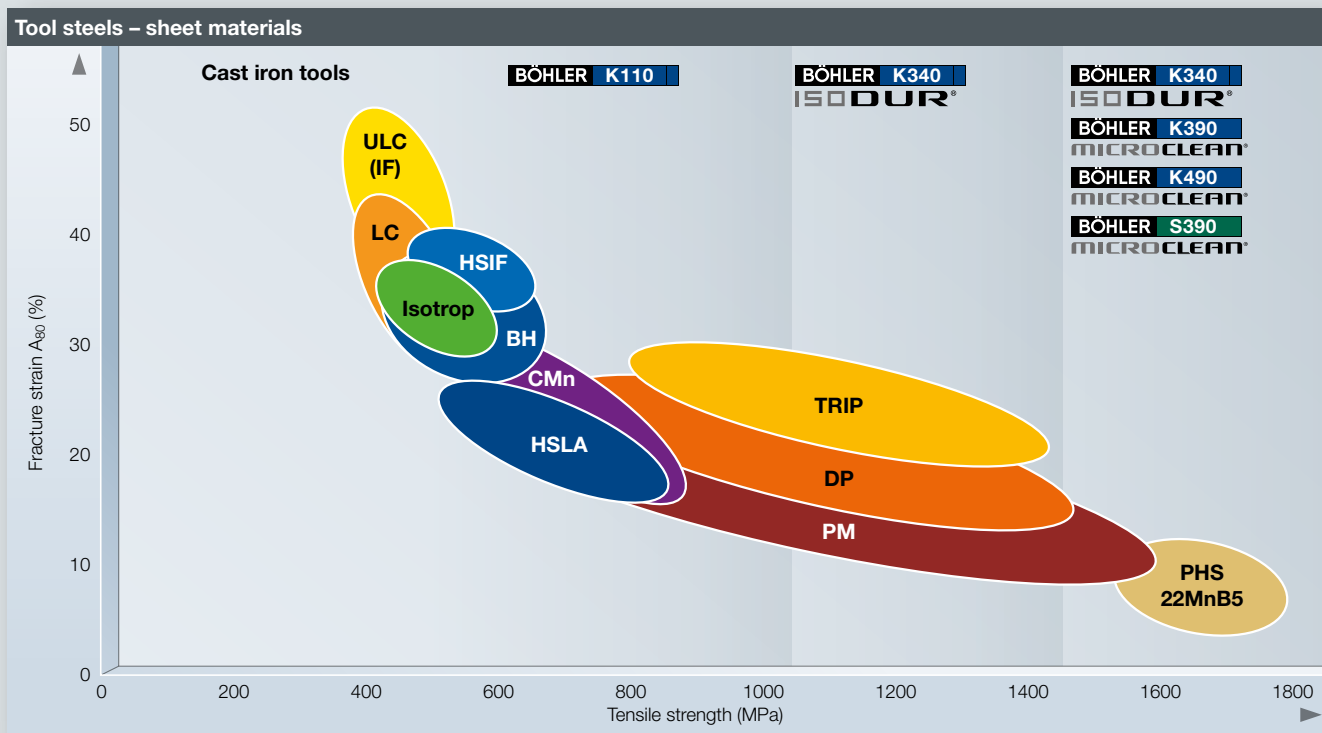
- Shorter and cheaper production processes due to a flexible heat treatment and an excellent hard machinability
- Higher tool life due to the excellent and stable mechanical properties

Properties

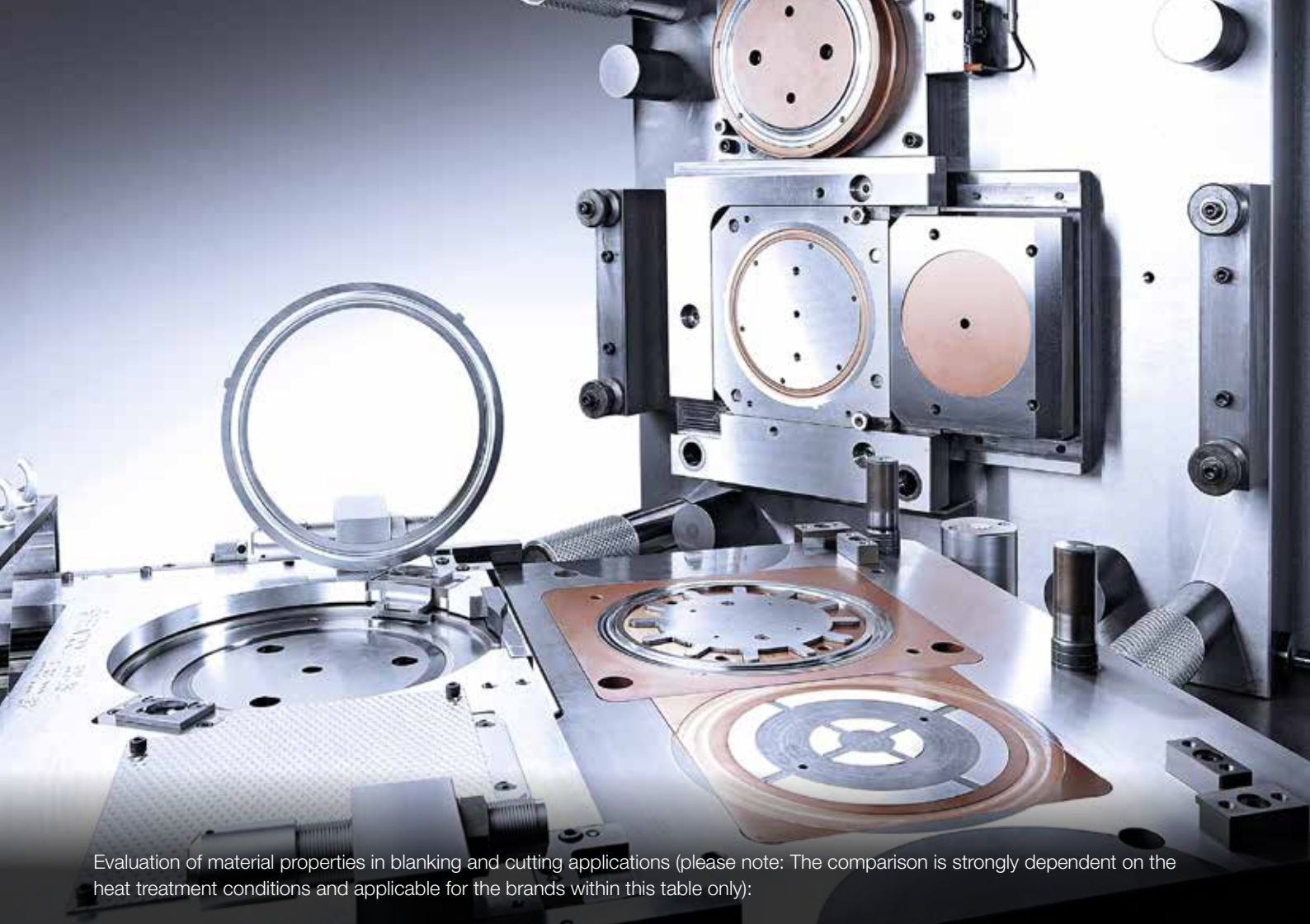
- High hardness (64 HRc)
- Very good toughness
- High abrasive and adhesive wear resistance
- Excellent hard machinability
- High compressive strength
- Heat treatment together with common cold work steels (1.2379, D2) at hardening temperatures from 1030 to 1080 °C possible
- Stable mechanical properties



Materials used for cutting, punching and blanking of high-strength and ultrahigh-strength sheets



- | | | | | | |
|-----------|-------------------------|--------|--|-------|----------------------------|
| ● ULC | Ultra low carbon steels | ● BH | Bake-hardening steels | ● DP | Dual phase steels |
| ● LC | Low carbon steels | ● HSLA | High-strength low alloyed steels | ● PM | Partial martensitic steels |
| ● HSIF | High strength IF steels | ● TRIP | Transformation induced plasticity steels | ● PHS | Presshardened steels |
| ● Isotrop | Isotropic steels | ● CMn | Carbon manganese steels | | |



Evaluation of material properties in blanking and cutting applications (please note: The comparison is strongly dependent on the heat treatment conditions and applicable for the brands within this table only):

BOHLER grade	Wear resistance		Toughness	Compressive strength	Dimensional stability in heat treatment
	abrasive	adhesive			
BOHLER K100	★★★	★★	★	★★	★★
BOHLER K110	★★★★	★★	★	★★	★★
BOHLER K305	★	★	★★★★★	★	★
BOHLER K340 ISO DUR®	★★★	★★★★★	★★★	★★★★★	★★★★
BOHLER K353	★★★	★★★★	★★★★★★	★★	★★
BOHLER K360 ISO DUR®	★★★★★	★★★★★	★★	★★★★★	★★★★
BOHLER K390 MICRO CLEAN®	★★★★★★	★★★★★★	★★★★★	★★★★★★	★★★★★
BOHLER K455	★	★	★★★★★★	★	★
BOHLER K490 MICRO CLEAN®	★★★★★	★★★★★	★★★★★★	★★★	★★★★★
BOHLER K600	★	★	★★★★★★	★	★
BOHLER K890 MICRO CLEAN®	★★★	★★★★	★★★★★★	★★★★★	★★★★★
BOHLER S600	★★★	★★	★★★	★★★	★★★
BOHLER S290 MICRO CLEAN®	★★★★★★	★★★★★★	★	★★★★★★	★★★★★★
BOHLER S390 MICRO CLEAN®	★★★★★	★★★★★	★★★★★	★★★	★★★★★
BOHLER S690 MICRO CLEAN®	★★	★★★★	★★★★★★	★★★	★★★
BOHLER W360 ISO BLOC®	★	★	★★★★★★	★	★

HOT WORK TOOL STEELS



HOT WORK
TOOL STEEL

Tool load

Hot work tool steels applied in hot forming processes such as die casting, forging or extrusion may be damaged on multiple and complex occasions. Damages may arise by collective stress factors combining high mechanical strengths, high temperatures and temperature gradients, whereas the individual stress factors dependent on process type and processing exert variably strong effects on the material. Material hardness, material strength, toughness, ductility and thermal conductivity are vital hot work tool steel properties when it comes to damage mechanisms to be avoided or delayed.



As the leading producer of tool steels worldwide BÖHLER is focused on offering solutions for the demanding requirements on hot working tool steels.

Hot wear resistance, hot toughness, hot strength, retention of hardness, thermal shock resistance as well as thermal conductivity are characterized not only by the composition of the hot work tool steel but are metallurgical features regulated during the melting and re-melting process.

Our experience and on-going research lead to the continuous improvement of the metallurgical properties by further developments in the melting and remelting process of hot work tool steels and their heat treatment.

3 qualities for special applications:

ISODISC®

- Conventional hot work tool steels
- Special heat treated

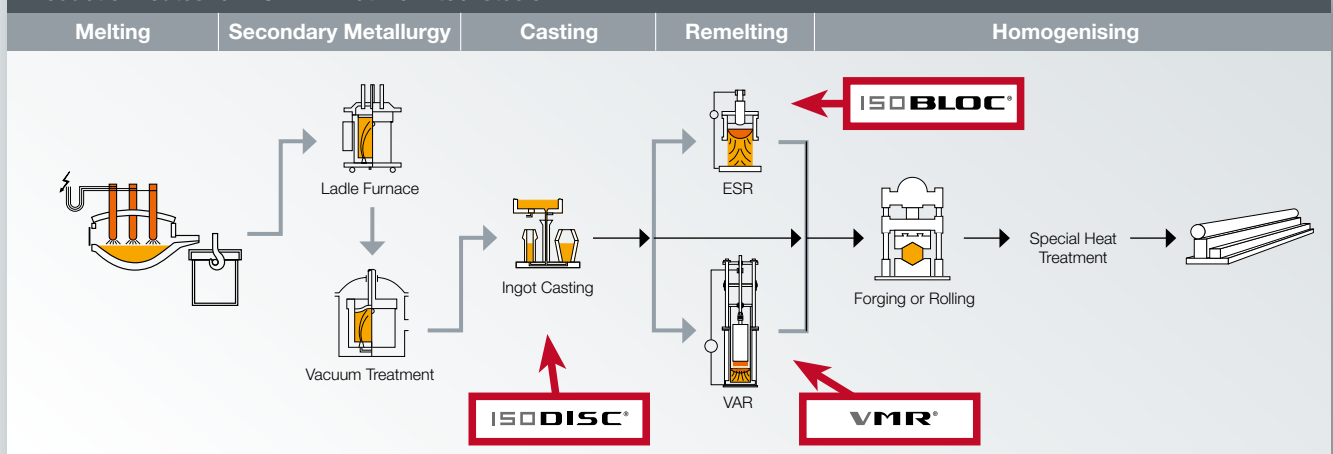
ISOBLOC®

- Hot work tool steels, ESR quality
- Special heat treated

VMR®

- Hot work tool steels, VAR quality
- Special heat treated

Production routes for BÖHLER hot work tool steels



DIE CASTING

Heat treatment

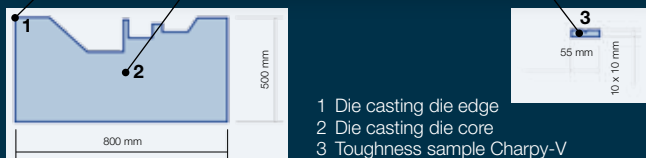
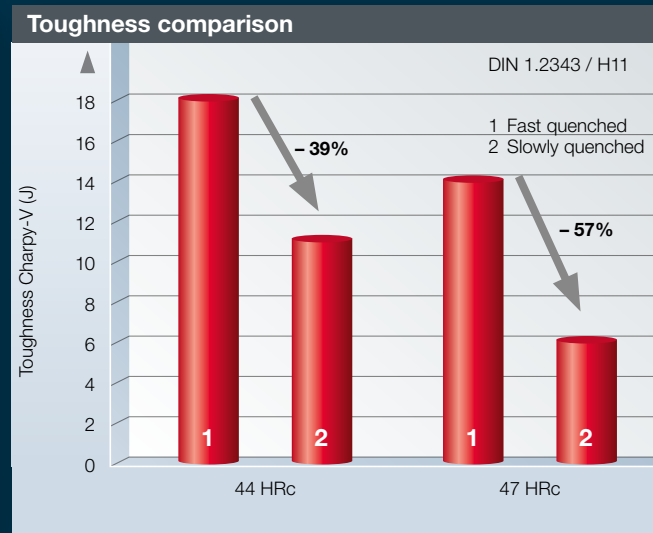
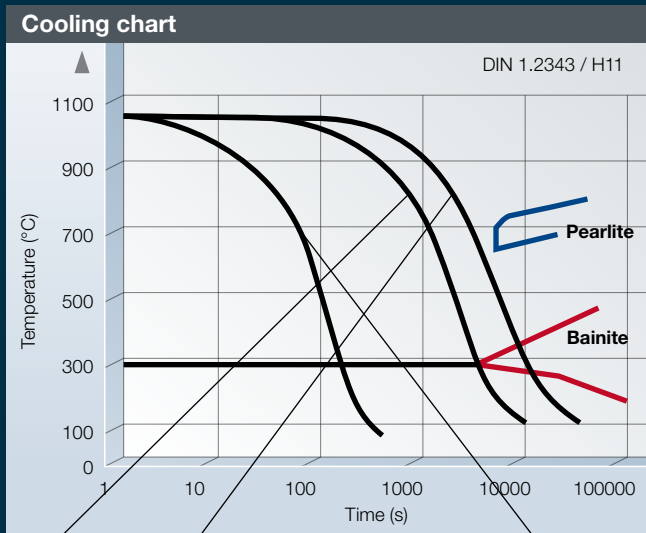
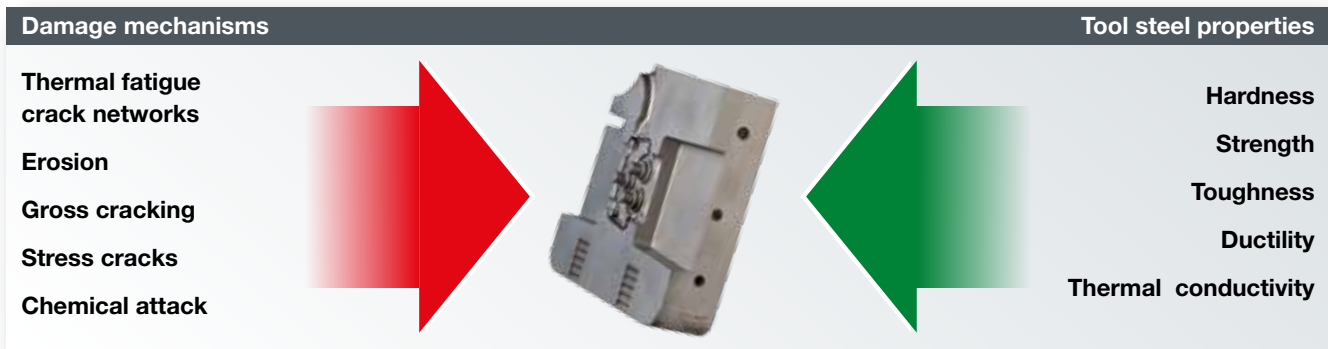
In order to achieve high toughness in tools, the cooling rate from the hardening temperature is of major importance. Cooling rate is primarily dependent on the tool size.

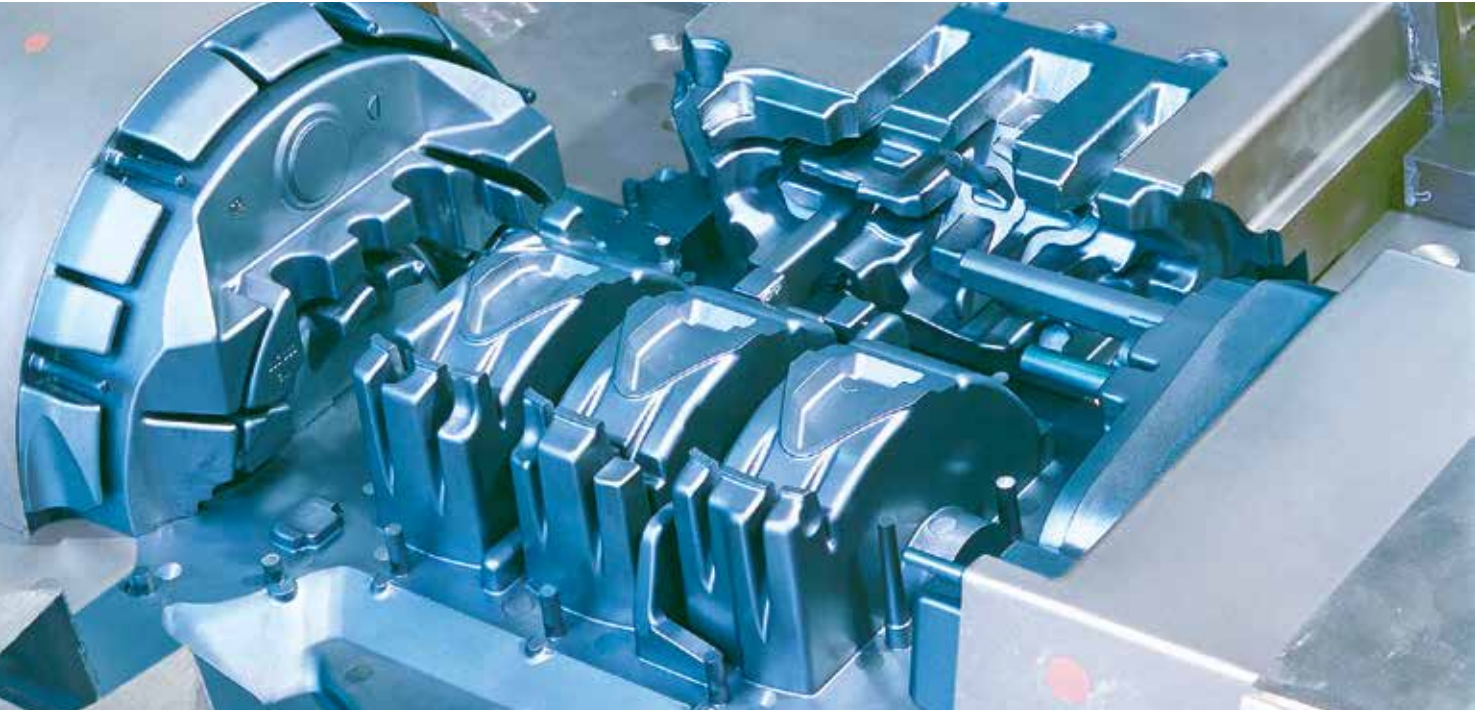
With increasing tool thickness, resulting in a reduced quenching rate, a change of microstructure occurs, leading to a significant decrease of toughness.

NADCA material approval

- BÖHLER W300 ISOBLOC
- BÖHLER W302 ISOBLOC
- BÖHLER W350 ISOBLOC
- BÖHLER W400 VMR
- BÖHLER W403 VMR

The quality of a tool made of hot work tool steel is defined by its mechanic-technological properties. It largely depends on the metal alloy's chemical composition, on the tool material's production process (electro slag remelting, vacuum remelting, forging and annealing technologies) and finally on the tool's heat treatment.





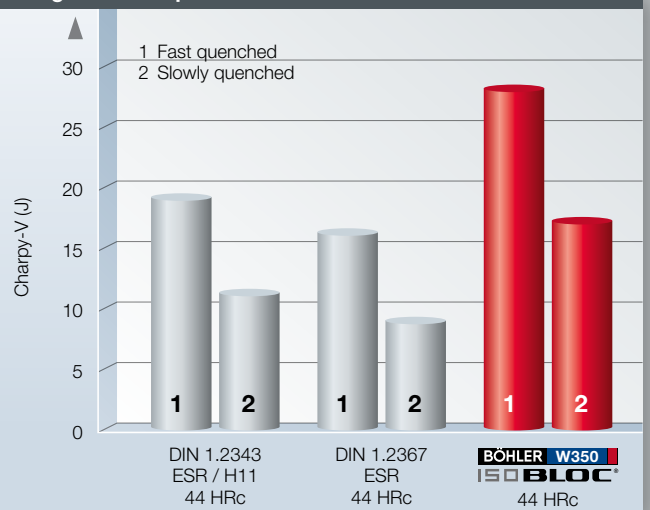
With the development of **W350 ISOBLOC**, BÖHLER Edelstahl allows large tool sizes for complex loads in hot forming and for effects of heat treating.

A balanced alloy composition ensuring high toughness even in large tools and an improved thermal stability opts for an optimal hardness/strength-toughness/ductility ratio (elongation after fracture and percentage reduction of area after fracture) tailor-fit to every application.

A pressurized remelting process (pressure ESR) coupled with optimized forging technology in three dimensions guarantees a high degree of homogeneity of the microstructure and the material properties. A high degree of purity can also be realized.

Hot work steel BÖHLER W350 ISOBLOC is characterized by a significantly higher level of toughness for a fast and a slow cooling from the hardening temperature compared with standard materials DIN 1.2343 and 1.2367.

Toughness comparison



The reduced cooling velocity leads to a significant decrease of toughness. If the hardness is increased, the decrease in toughness is even higher.

FORGING

The demands on forging die steels are primarily determined by the respective forging process but also by the shape and properties of the material the components are to be made of. As a result, the demands on the die steel are derived, such as

- High thermal shock resistance
- High hot strength
- High retention of hardness
- Exceptional high hot toughness
- High hot wear resistance
- Improved thermal conductivity
- Good heat checking resistance



Drop forging

Drop forging is carried out by impacting material with a hammer or by applying a great amount of pressure with a forging press or forging machine.

When forging with a **hammer** the forging piece is only in contact with the die for a short period of time. Due to this, the die has to withstand lower temperatures. However, the **mechanical stress is high**. Thus, it is quite important for the hot work tool steel used to have very good toughness properties.

Compared with that, the contact during **forging pressing** occurs over a longer period of time, which then causes a **higher temperature strain on the tool**. Thus, in such a case hot work tool steels with a chromium-molybdenum base are used, which are singled out as having good tempering resistance, high temperature strength, hot wear resistance, and hot toughness.

Rapid forging

A fully automatic multi-stage press is forging equipment that produces even the **most difficult shapes from materials hard to deform in several stages of deformation**. This equipment mostly produces **rotation symmetric parts**. Heating the slugs, feeding, shearing and deforming take place completely automatically.

Semi hot forging

The term semi hot forging refers to a deformation process in which **the workpiece is preheated to such a point that permanent strain hardening** occurs under the given deformation conditions. This definition means that the material is deformed below the recrystallization temperature, yet the term is also used for temperatures occurring above this. In practice this is understood to be the deformation of steel in the temperature range of 650 to approx. 950 °C. These temperatures lie significantly below the conventional forging temperatures of 1100 – 1250 °C.

Requirement profile	Drop forging with hammer	Drop forging with press	Semi hot forging
Wear resistance	★★★★★	★★★★★	★★★★★
Retention of hardness	★★	★★★★	★★★★
High temperature strength	★★★	★★★★	★★★★★
Heat checking resistance	★	★★	★
High temperature toughness	★★★★	★★★★	★★



BÖHLER W360 ISOBLOC was developed as a tool steel for dies and punches in semi-hot and hot forging. It owes its excellent properties to a patented alloying concept and the electroslag remelting (ESR) process. This grade can be used for a variety of applications where **hardness** and **toughness** are required.

Properties

- High hardness (recommended in use: 52 – 57 HRc)
- Exceptional toughness
- High temper resistance
- Good thermal conductivity
- Can be cooled with water
- Homogeneous microstructure

Applications and uses

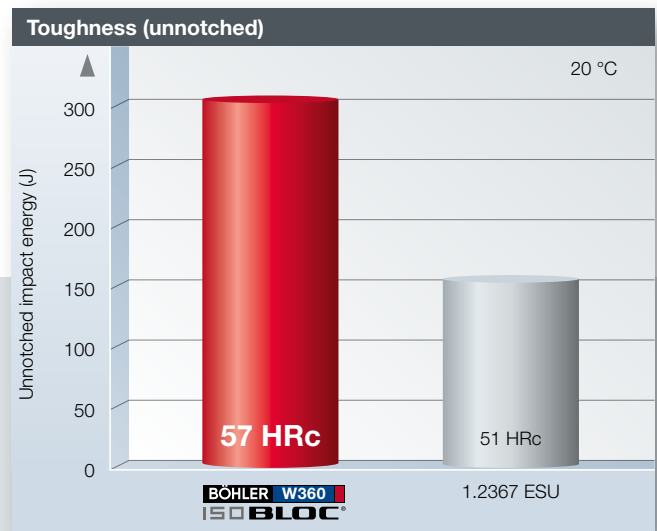
- Dies and punches in warm and hot forging
- Tooling for high speed presses
- Toughness-critical cold work applications
- Extrusion tooling, e.g. dies
- Core pins and inserts in die-casting dies
- Specific applications in the plastic processing sector

Toughness

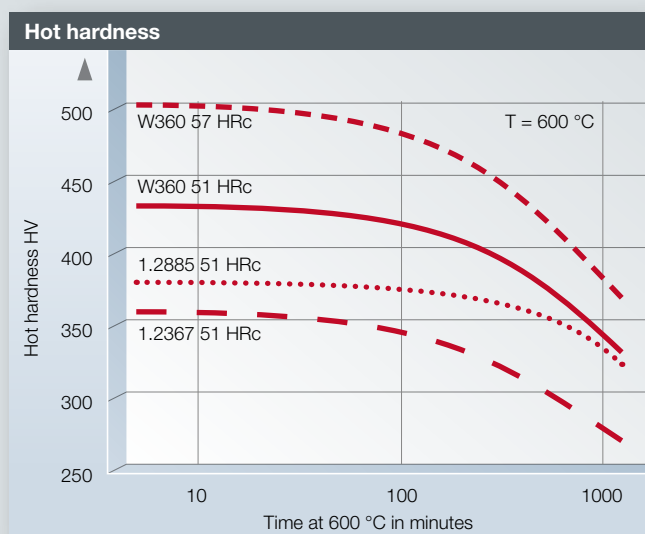
The toughness of hot work tool steels is one of the most important properties for safety against fracture and increased resistance to heat-checking and thermal shock. High hardness is usually associated with low toughness. This is not the case for W360 ISOBLOC.

Hot hardness

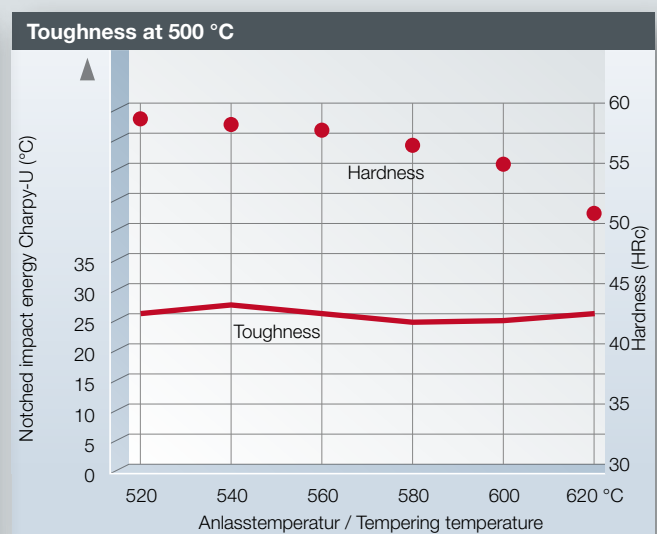
Alongside the outstanding toughness, W360 ISOBLOC is distinguished by its high thermal stability. This is reflected in the high hot hardness and the stability of the material under thermal loading. These properties, combined in W360 ISOBLOC, ensure a high resistance to thermal fatigue and catastrophic failure.



BÖHLER W360 ISOBLOC has a significantly higher toughness than 1.2367 ESU – at a higher hardness.



At 51 HRc, BÖHLER W360 ISOBLOC has a higher hot hardness than 1.2885 and 1.2367. If the hardness of BÖHLER W360 ISOBLOC is increased to 57 HRc, then the result is a further increase in the hot hardness.



Looking at the toughness over tempering temperature (hardness) it can be seen that the toughness of BÖHLER W360 ISOBLOC is almost constant from 51 to 57 HRc.

ROD EXTRUSION



Rod extrusion

Highly stressed extrusion tools require a high degree of metallurgical cleanliness, excellent homogeneity and best toughness at high working hardness. These requirements are met by selected BÖHLER hot work tool steels for the extrusion industry.

- **Increased heat checking resistance**
- **Reduced hot wear**
- **Increased hot strength**
- **Higher working hardness**
and therefore
- **Longer tool life**

That increases the productivity, lowers the unit costs and makes the final product more competitive.

Requirement profile	Mantle	Liner holder	Liner	Stem
Wear resistance	★	★	★★★★★	★★
Hot hardness	★★★★	★★★★	★★★★★	★★★★★
High temperature strength	★★★★	★★★★★	★★★★★	★★★★
Creep resistance	★★★★★★	★★★★★★	★★★★	★
Heat checking resistance	★	★	★★★★★	★
Compressive strength	★	★★★★	★★	★★★★★★
High temperature toughness	★★★★	★	★★★★	★★

Evaluation of material properties

BOHLER grade	High temperature strength	High temperature toughness	High temperature wear resistance	Machinability
BOHLER W300 ISODISC®	★★	★★★★	★★	★★★★★★
BOHLER W300 ISOBLOC®	★★	★★★★	★★	★★★★★★
BOHLER W302 ISODISC®	★★★★	★★★★	★★★★	★★★★★★
BOHLER W302 ISOBLOC®	★★★★	★★★★	★★★★	★★★★★★
BOHLER W303 ISODISC®	★★★★★	★★★★	★★★★★	★★★★★★
BOHLER W320 ISODISC®	★★★★	★★	★★★★	★★★★★★
BOHLER W321 ISODISC®	★★★★★	★★	★★★★★	★★★★★★
BOHLER W350 ISOBLOC®	★★★★	★★★★★★	★★★★★	★★★★★★
BOHLER W360 ISOBLOC®	★★★★★★	★★★★★	★★★★★★	★★★★★★
BOHLER W400 VMR®	★★	★★★★★★	★★	★★★★★
BOHLER W403 VMR®	★★★★★	★★★★★	★★★★★	★★★★★
BOHLER W500	★	★★★★	★	★★★★
BOHLER W720 VMR®	Maraging steels (ageing temperature about 480 °C), in this form not comparable with the heat treatable steels.			
BOHLER W722 VMR®				

For specific applications and selection of proper material and working hardness please refer to our technical sales staff.

PLASTIC MOULD STEELS

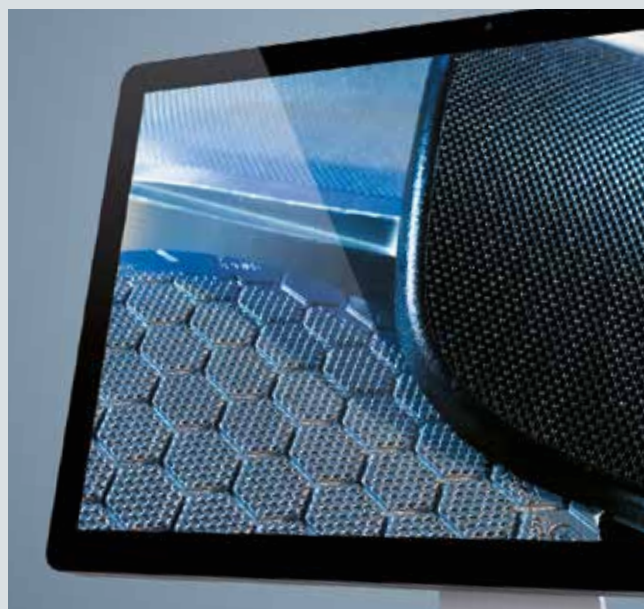


PLASTIC MOULD
STEEL



To meet the highest demands BÖHLER plastic mould steels are the ultimate solution to any application in the manufacture of mould and machine parts, meeting the highest expectations of users as regards shape, function, aesthetics, product quality and durability. BÖHLER steels are of a guaranteed consistent quality and developed for the most stringent future demands.

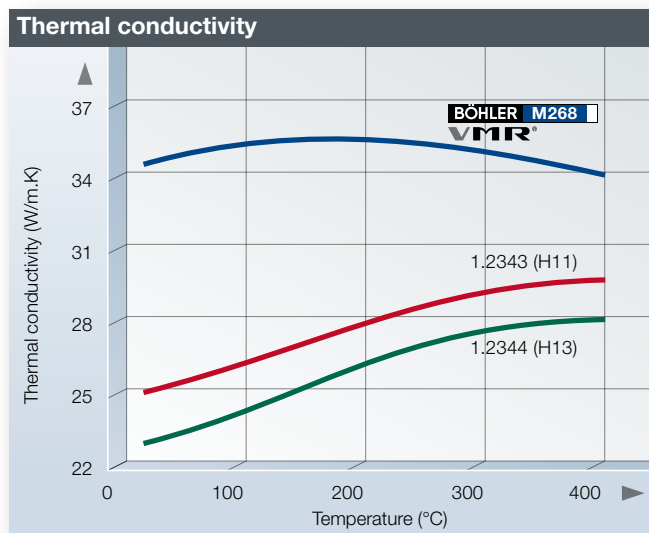
As a **mould maker** you certainly know of all the demands a product should meet. BÖHLER, therefore, offers you competent material consulting on the steel, its properties and the heat treatment to meet your requirements best.



BÖHLER M268 VMR®



BÖHLER M268 VMR is a hardened and tempered plastic mould steel with excellent cleanliness for best polishability. The hardness is constant over the entire cross-section of the steel block, even at large sizes, due to the addition of nickel.



Applications

Moulds for plastics processing, components for general mechanical engineering and tool manufacture where highest polishability and fatigue strength are required.

Condition of supply

Hardened and tempered to 350 – 400 BHN, High-hard. Generally, no heat treatment is required. If heat treatment is carried out, e.g. to obtain an increase in strength, the instructions given in this brochure should be observed.

Mirror Polishability

The excellent cleanliness of **BÖHLER M268 VMR**, achieved by the vacuum remelting technology, has a positive impact on the polishability of large moulds and complex geometries.

Optimizing of cycle times

The high thermal conductivity guarantees a reduction of cycle time and increases the efficiency of the production process.

Further advantages of our hardened and tempered plastic mould steel BÖHLER M268 VMR:

- Suitable for all nitriding processes to improve wear resistance
- Can be hard chromium plated. Suitable for every type of galvanic surface treatment used to optimize hardness and corrosion resistance
- Suitable for PVD coating, providing excellent adhesion conditions for the TiN-layer
- The material can be induction-hardened if necessary
- Suitable for photo-etching

Advantages and benefits

The economic and technological advantages of **BÖHLER M268 VMR** at a glance:

Higher quality

- Uniformly high strength and toughness, even at larger sizes
- High through hardenability
- Excellent thermal conductivity

Efficient tool making

- No heat treatment required
- Excellent, high polishability
- Good texturing properties
- Good electrical discharge machining properties

Reliability

- The material does not require heat treatment, reducing the risk of errors
- The good toughness decreases the risk of cracking during service

= Improved productivity and cost reduction

BÖHLER M303 EXTRA



The new classic

BÖHLER M303 EXTRA is a corrosion resistant martensitic chromium steel, offering **excellent toughness, corrosion and wear resistance**. It is characterized by **improved machinability and polishability**.

And what is special about it – BÖHLER M303 EXTRA was developed for improved homogeneity ensuring excellent usage properties. And the outcome is – compared to 1.2316 – the prevention of delta ferrite in the matrix.

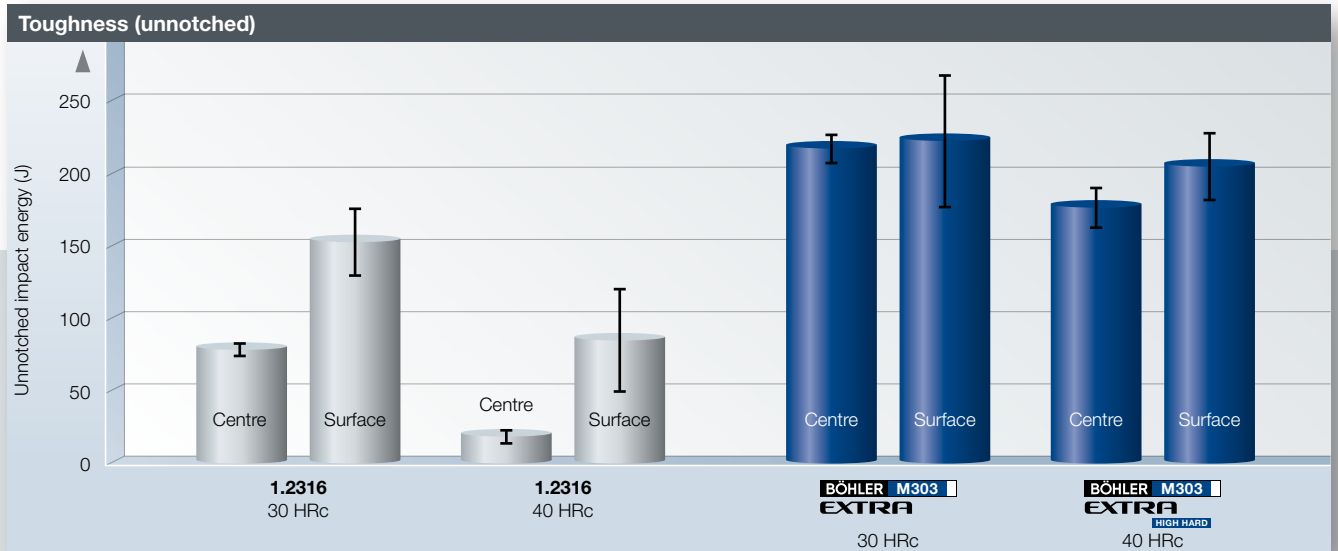
This material is also offered by BÖHLER in the **"High-Hard"-version**, with a significantly better wear resistance.

BÖHLER M303 EXTRA

Hardened and tempered:
290 – 330 HB

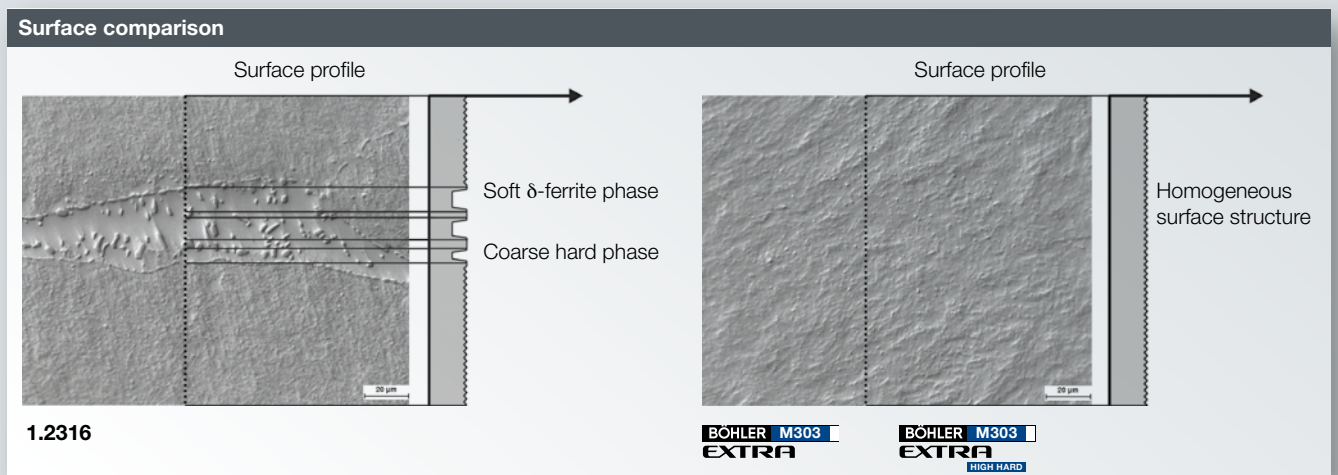
BÖHLER M303 EXTRA HIGH HARD

Hardened and tempered:
350 – 390 HB



Comparisons made with 1.2316 show that **BÖHLER M303 EXTRA** has a more regular and improved toughness over the

block zones thus ensuring a better fracture resistance and avoiding unexpected downtimes.



In the case of 1.2316, the hard carbide phases being imbedded in the soft delta ferrite zone, are causing an

irregular polish. In contrast **BÖHLER M303 EXTRA** shows regular polish.

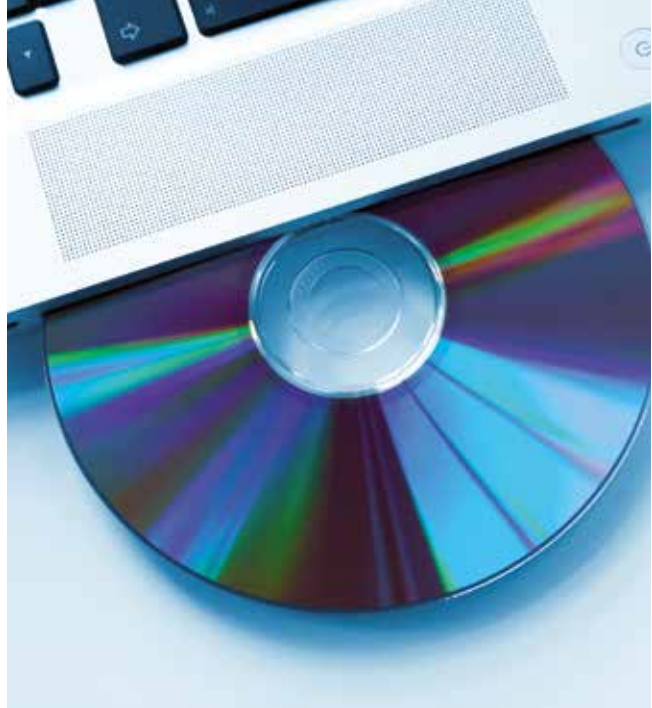
BÖHLER M333 **ISOPLAST®**



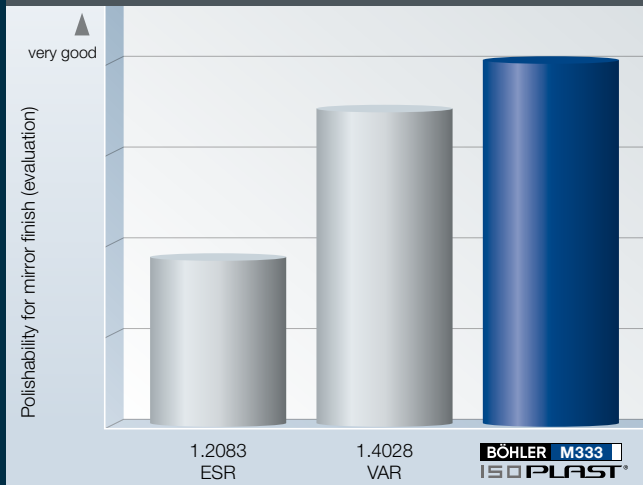
A product is only as good as the surface finish of the tool in which the product is formed. Particularly in the field of mirrored finishes no mistakes are condoned. Irregularities on the surface are immediately visible. Until now it has been particularly time-consuming and costly for toolmakers to produce inserts with a mirrored finish. That effort was coupled with the fact that the finished results were less than satisfactory.

Advantage of BÖHLER M333 ISOPLAST at a glance:

- Optimum polishability for mirror finish
- Improved thermal conductivity
- Exceptional toughness and hardness
- Very good corrosion resistance

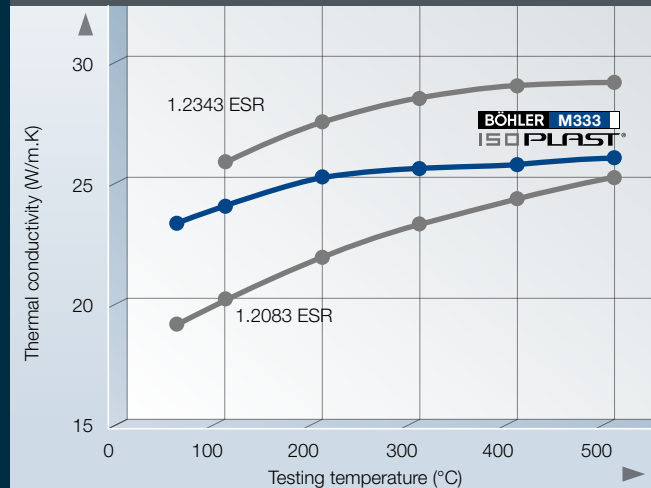


Quick high-grade polish in no time at all (tests from the lab and in action)



Mean values of the findings of several Austrian and German companies regarding time and quality after mechanical and handpolishing of 6 samples of each material.

Shorter cycle time and higher productivity due to improved thermal conductivity. Your tool stays "cool".



Source: Materials Center Leoben Forschung GmbH, ÖGI

BÖHLER M390
MICROCLEAN®



BÖHLER M390 MICROCLEAN is a martensitic chromium steel produced with powder metallurgy. Due to its alloying concept this steel offers **extremely high wear resistance** and **high corrosion resistance** – the perfect combination for **best application properties**.

- Extremely high wear resistance
- High corrosion resistance
- Excellent grindability
- High mirrorfinish polishability
- High toughness
- Minimum dimensional changes
- Better resistance to vibrations and mechanical shocks

enable

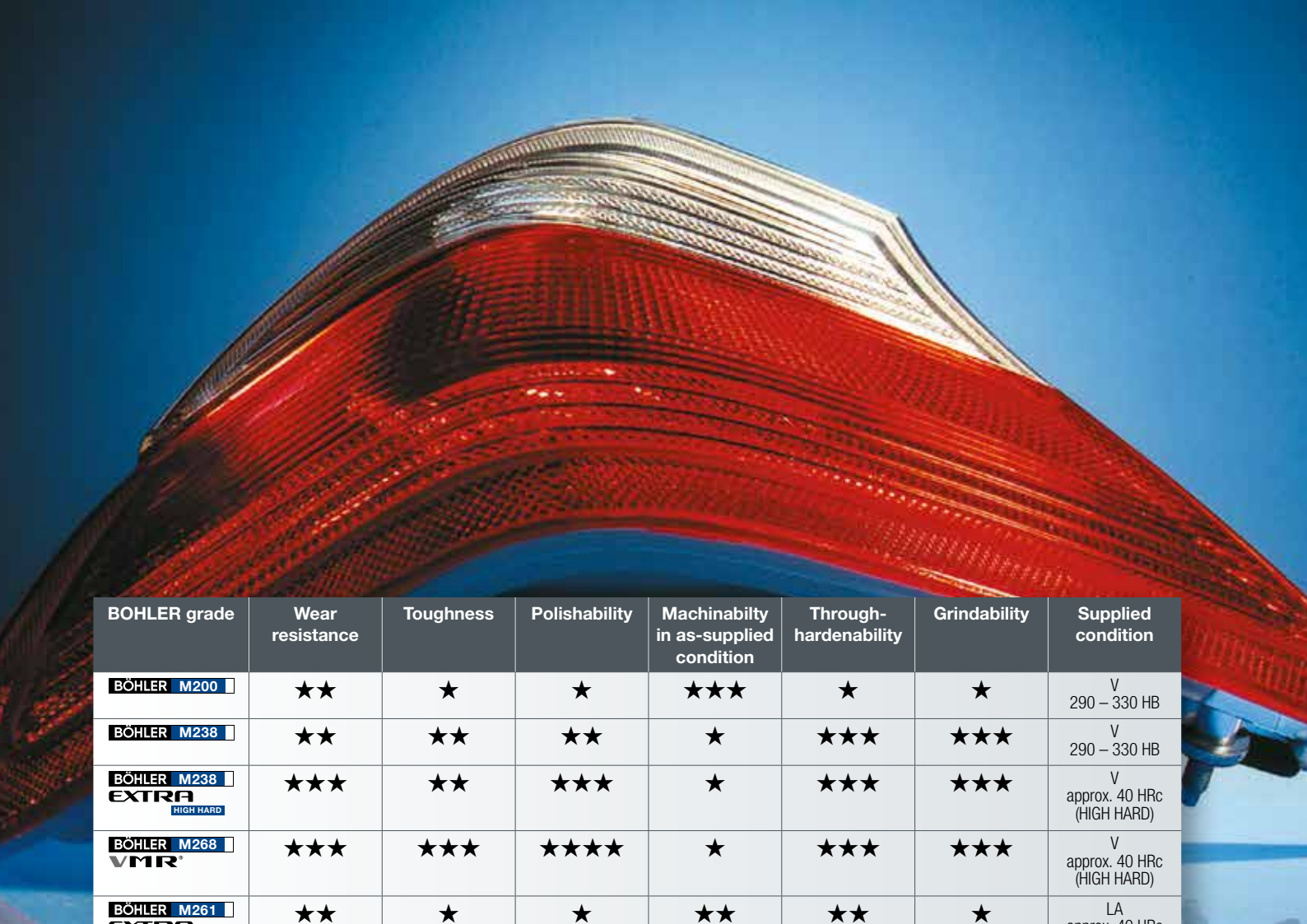
- Long and constant tool life
- Reproducibility of production processes
- High precision components

Benefit

- **Increased productivity**
- **Reduced unit costs**

Field of applications

- Mould inserts for the production of CDs and DVDs
- Moulds for the processing of chemically aggressive plastics containing highly abrasive fillers
- Moulds for the processing of duroplasts
- Moulds for the production of chips for the electronics industry
- Screws for injection moulding machines
- Non return valves
- Linings for injection moulding cylinders



BOHLER grade	Wear resistance	Toughness	Polishability	Machinability in as-supplied condition	Through-hardenability	Grindability	Supplied condition
BOHLER M200	★★	★	★	★★★★	★	★	V 290 – 330 HB
BOHLER M238	★★	★★	★★	★	★★★★	★★★★	V 290 – 330 HB
BOHLER M238 EXTRA HIGH HARD	★★★★	★★	★★★★	★	★★★★	★★★★	V approx. 40 HRc (HIGH HARD)
BOHLER M268 VMR	★★★★	★★★★	★★★★★	★	★★★★	★★★★	V approx. 40 HRc (HIGH HARD)
BOHLER M261 EXTRA	★★	★	★	★★	★★	★	LA approx. 40 HRc

BOHLER grade	Corrosion resistance	Wear resistance	Toughness	Polishability	Machinability in as-supplied condition	Supplied condition
Heat treated, corrosion resistant steels *						
BOHLER M303 EXTRA	★★★★	★★	★★	★★★★	★	V approx. 1000 N/mm ²
BOHLER M303 EXTRA HIGH HARD	★★★★	★★★★	★★	★★★★	★	V approx. 40 HRc
BOHLER M314 EXTRA	★★	★	★	★★	★★	V approx. 1000 N/mm ²
BOHLER M315 EXTRA	★★	★	★	★	★★★★	V approx. 1000 N/mm ²
BOHLER N700	★★★★	★★	★★★★	★★★★	★	V approx. 1500 N/mm ²
Hardenable, corrosion resistant steels *						
BOHLER M310 ISOPLAST®	★★	★★	★	★★	★★★★	W max. 225 HB
BOHLER M333 ISOPLAST®	★★	★★	★★★★	★★★★	★★★★	W max. 220 HB
BOHLER M340 ISOPLAST®	★★★★	★★★★	★	★	★★	W max. 260 HB
BOHLER M390 MICROCLEAN	★★★★	★★★★	★★	★★★★	★	W max. 280 HB
BOHLER N685	★	★★★★	★	★	★	W max. 265 HB

Evaluation of material properties in plastic moulding applications (Please note: The comparison is applicable for the brands of each group only); For particular requirements in terms of corrosion resistance, wear resistance or dimensional stability please consult our technical sales staff.

W Soft annealed
V Hardened and tempered to obtain good mechanical properties

LA Solution annealed and precipitation hardened
* The profiles given are characteristic of each group of steels.

THE PRODUCTION PROCESS

MICROCLEAN®



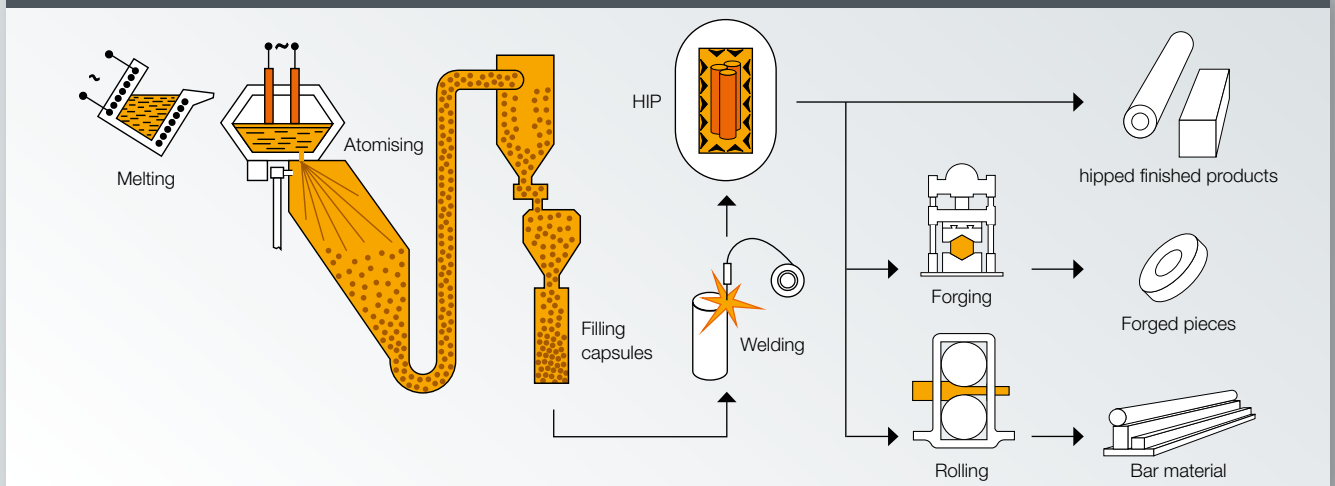
POWDER
METALLURGY

3rd generation high speed steels and tool steels made from uniquely fine, pure powder produced in the world's most modern PM plant at BÖHLER Edelstahl in Kapfenberg, Austria.

- High homogeneity
- Improved toughness
- High fatigue resistance
- Optimal reliability
- Uniquely consistent properties

High purity, homogeneous alloyed powders, with appropriate particle size and distribution are subjected to a high pressure, high temperature process to obtain a homogeneous, segregation-free tool steel with virtually isotropic properties.

Production routes for BÖHLER MICROCLEAN





BOHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN/ EN	AISI
BOHLER S290 MICROCLEAN®	2.00	0.50	0.30	3.80	2.50	–	5.10	14.30	11.00	–	Patent	–
BOHLER S390 MICROCLEAN®	1.64	0.45	0.30	4.80	2.00	–	4.80	10.40	8.00	–	–	–
BOHLER S590 MICROCLEAN®	1.29	0.60	0.30	4.20	5.00	–	3.00	6.30	8.40	–	1.3244 HS6-5-3-8	–
BOHLER S690 MICROCLEAN®	1.35	0.60	0.30	4.10	5.00	–	4.10	5.90	–	–	~ 1.3351 ~ HS6-5-4	~ M4
BOHLER S790 MICROCLEAN®	1.29	0.60	0.30	4.20	5.00	–	3.00	6.30	–	–	1.3345 HS6-5-3C	~ M3 Cl.2
BOHLER K390 MICROCLEAN®	2.47	0.55	0.40	4.20	3.80	–	9.00	1.00	2.00	–	Patent	–
BOHLER K490 MICROCLEAN®	1.40	–	–	6.40	1.50	–	3.70	3.50	–	Nb	–	–
BOHLER K890 MICROCLEAN®	0.85	0.55	0.40	4.35	2.80	–	2.10	2.55	4.50	–	Patent	–
BOHLER M390 MICROCLEAN®	1.91	0.60	0.30	20.00	1.00	–	4.00	6.00	–	–	Patent	–

BOHLER has improved the production process for powder metallurgy high speed steels and tool steels. MICROCLEAN materials of the 3rd generation with improved performance features are produced in Kapfenberg on the most modern unit worldwide. An extensive assortment of cold work, plastic mould and high speed steels provides our customers with a definitive competitive advantage.

BOHLER MICROCLEAN have the following advantages:

- Extremely high wear resistance
- Excellent corrosion resistance
- Optimum grindability
- Easily polishable to a high mirror finish
- High toughness
- Only minor isotropic dimensional changes
- Repeatable production processes
- Better resistance to vibrations
- More resistance to mechanical shocks

enable ↓

- High precision components
- Long tool life
- Consistant tool life

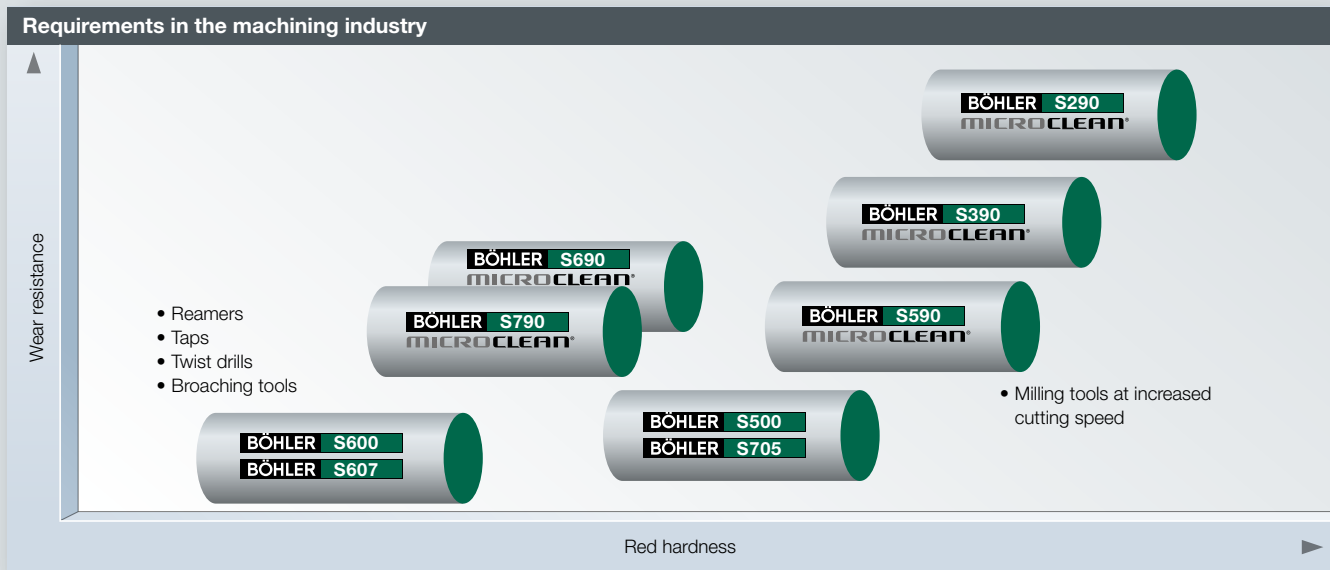
ensuring ↓

- **Increased productivity**
- **Reduced unit costs**



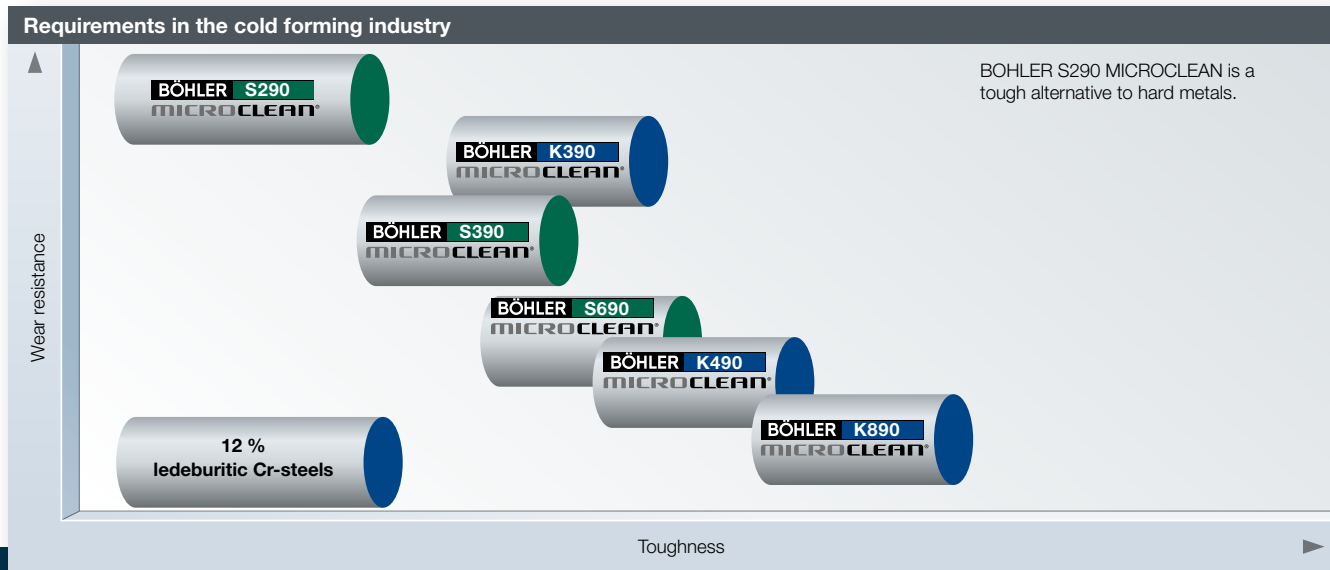
Requirements in the machining industry

The efficiency of a machining tool depends on the **wear resistance, red hardness, toughness** and **compressive strength** of the tool material.



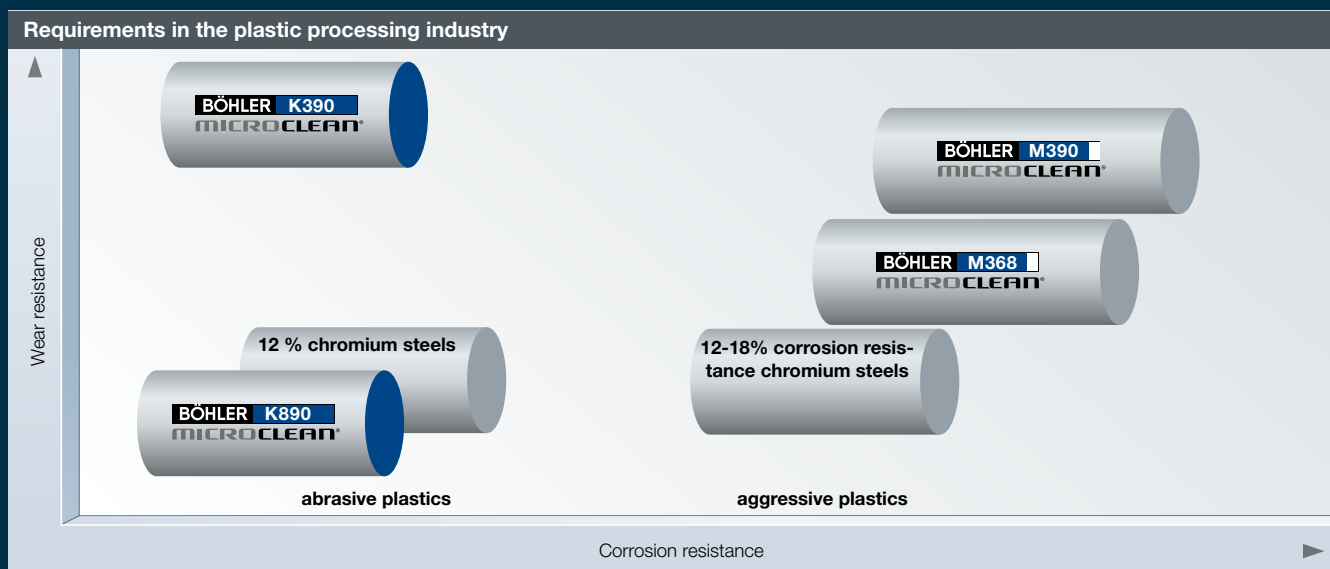
Requirements in the cold forming industry

The service life of a cold work tool depends on the **wear resistance**, **toughness** and **compressive strength** of the tool material.

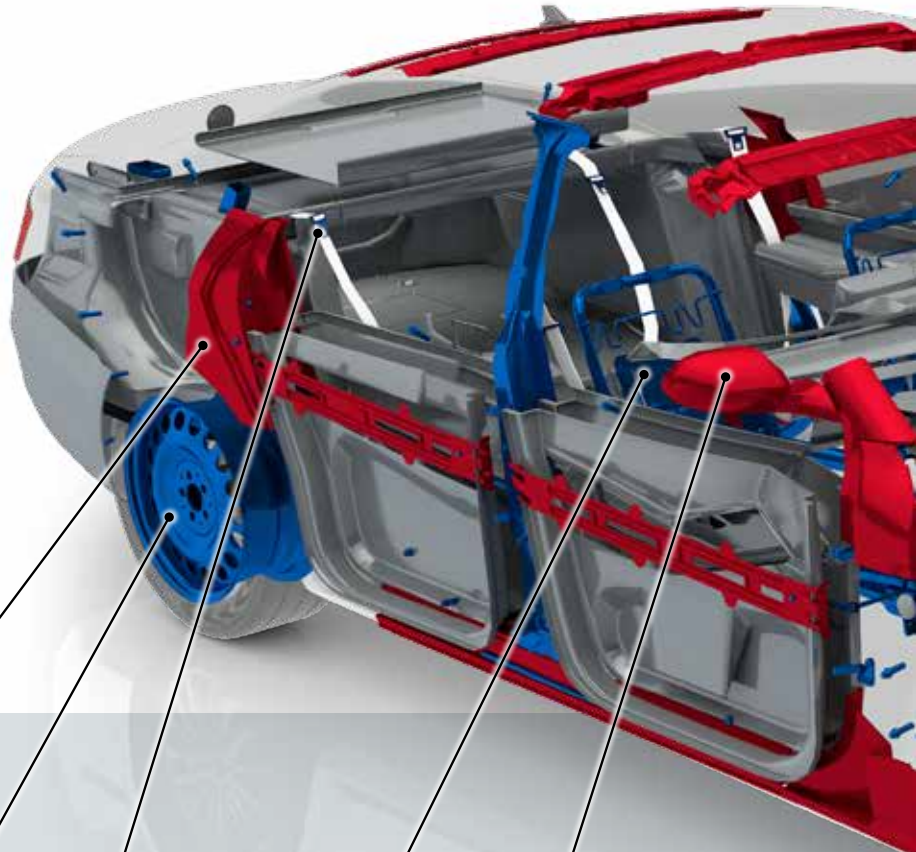


Requirements in the plastic processing industry

The major factors which influence the tool performance in the plastics processing industry are **wear resistance**, **corrosion resistance**, **toughness** and **polishability**.



BÖHLER – THE DRIVING FORCE IN THE AUTOMOTIVE INDUSTRY FOR HIGH PERFORMANCE TOOLING



LONGITUDINAL BEAMS – A-B-C-PILLAR, GEAR-BOX HOUSING, SIDE IMPACT PROTECTION MEMBER, BUMPER BEAMS

BÖHLER W350
ISOBLOC®
BÖHLER W360
ISOBLOC®
BÖHLER K340
ISODUR®
BÖHLER K353

WHEEL RIMS

BÖHLER K340
ISODUR®
BÖHLER W360
ISOBLOC®

BELT BUCKLE

BÖHLER K340
ISODUR®
BÖHLER K360
ISODUR®
BÖHLER K390
MICROCLEAN®
BÖHLER K490
MICROCLEAN®
BÖHLER S390
MICROCLEAN®

SEAT ADJUSTMENTS, HEADRESTS

BÖHLER K490
MICROCLEAN®
BÖHLER K890
MICROCLEAN®
BÖHLER S290
MICROCLEAN®
BÖHLER S390
MICROCLEAN®
BÖHLER S690
MICROCLEAN®

SIDE MIRRORS

BÖHLER K360
ISODUR®
BÖHLER K490
MICROCLEAN®
BÖHLER W350
ISOBLOC®
BÖHLER W360
ISOBLOC®

GEARBOX

BÖHLER W350
ISOBLOC®
BÖHLER W400
VMR®
BÖHLER W403
VMR®



COLD WORK
TOOL STEEL



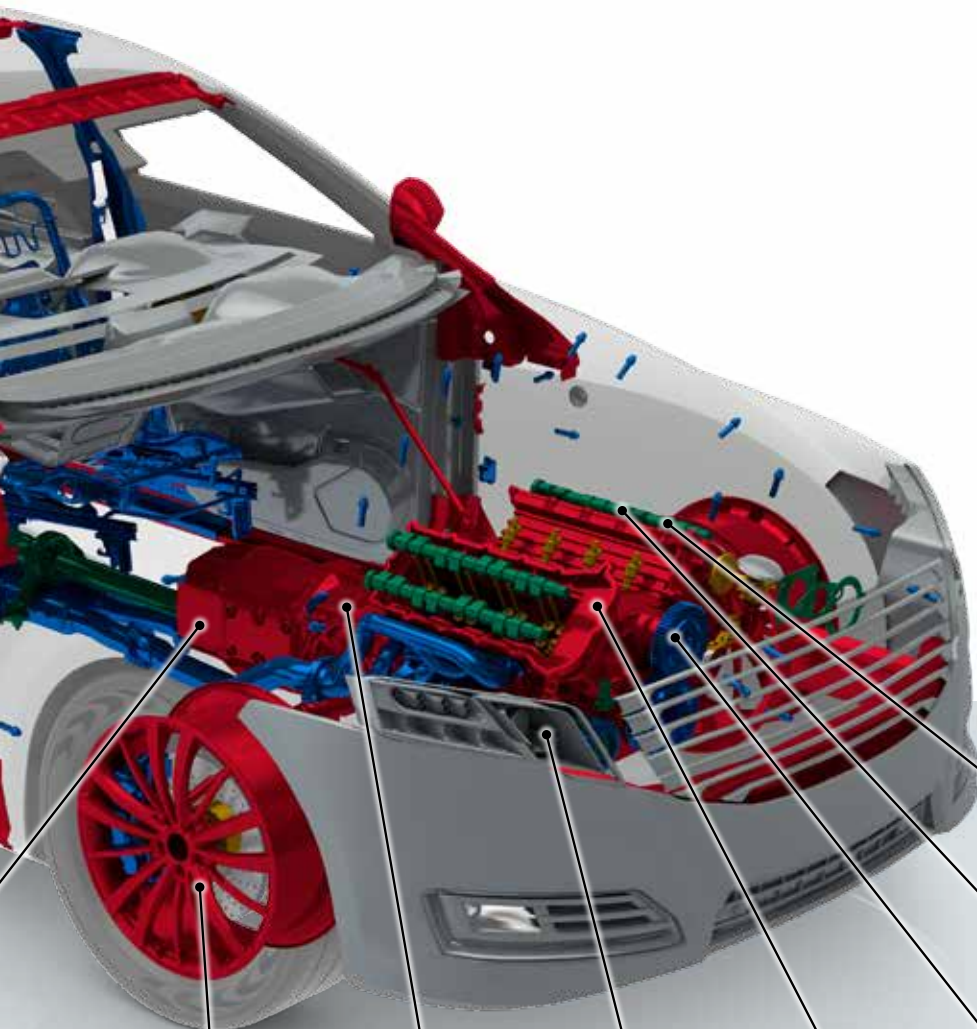
HOT WORK
TOOL STEEL



PLASTIC MOULD
STEEL



HIGH SPEED
STEEL



PISTON ROD

BÖHLER W360
ISOBLOC

WHEEL RIMS

BÖHLER W300
BÖHLER W300
ISOBLOC

CLUTCH

BÖHLER K390
MICROCLEAN
BÖHLER K490
MICROCLEAN
BÖHLER K890
MICROCLEAN
BÖHLER S390
MICROCLEAN
BÖHLER S790
MICROCLEAN

HEADLIGHTS

BÖHLER W300
ISOBLOC
BÖHLER W350
ISOBLOC
BÖHLER W400
VMR
BÖHLER M310
ISOPLAST
BÖHLER M333
ISOPLAST
BÖHLER M268
VMR

ENGINE HOUSING

BÖHLER W350
ISOBLOC
BÖHLER W400
VMR
BÖHLER W403
VMR

DRIVE BELT WHEEL

BÖHLER K390
MICROCLEAN
BÖHLER K490
MICROCLEAN
BÖHLER S390
MICROCLEAN
BÖHLER S690
MICROCLEAN
BÖHLER S790
MICROCLEAN

CAMSHAFT

BÖHLER W300
ISOBLOC
BÖHLER W350
ISOBLOC

HIGH SPEED STEELS



HIGH SPEED
STEEL

Comparison of the major high speed steel properties

(This comparison does not take into account the various stress conditions imposed on the tool in different kinds of application. Comparisons also depend very much on the

heat treatment conditions. Our technical sales staff will be glad to assist you in any questions concerning the application and heat treatment of our steels.)

BOHLER grade	Red hardness	Wear resistance	Toughness	Grindability	Compressive strength
BOHLER S500	★★★★★	★★	★★	★★★★	★★★★★
BOHLER S600	★★★	★★	★★★★	★★★★	★★★★
BOHLER S705	★★★	★★	★★★★	★★★★	★★★★
BOHLER S290 MICROCLEAN	★★★★★★	★★★★★★	★	★	★★★★★★
BOHLER S390 MICROCLEAN	★★★★★	★★★★★	★★★★★	★★★★	★★★★★
BOHLER S590 MICROCLEAN	★★★★★	★★★	★★★	★★★	★★★★★
BOHLER S690 MICROCLEAN	★★	★★★	★★★★★★	★★★★	★★★★
BOHLER S790 MICROCLEAN	★★	★★	★★★★★	★★★★	★★★★

BOHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN/ EN	AISI
BOHLER S500	1.10	0.50	0.25	3.90	9.20	–	1.00	1.40	7.80	–	1.3247 HS2-9-1-8	M42
BOHLER S600	0.90	max. 0.45	ma. 0.40	4.10	5.00	–	1.80	6.20	–	–	1.3343 HS6-5-2C	~ M2 reg. C
BOHLER S705	0.92	0.40	0.30	4.10	5.00	–	1.90	6.20	4.80	–	1.3243 HS6-5-2-5	(~ M35) ~ M41
BOHLER S290 MICROCLEAN	2.00	0.50	0.30	3.80	2.50	–	5.10	14.30	11.00	–	Patent	–
BOHLER S390 MICROCLEAN	1.64	0.45	0.30	4.80	2.00	–	4.80	10.40	8.00	–	–	–
BOHLER S590 MICROCLEAN	1.29	0.60	0.30	4.20	5.00	–	3.00	6.30	8.40	–	1.3244 HS6-5-3-8	–
BOHLER S690 MICROCLEAN	1.35	0.60	0.30	4.10	5.00	–	4.10	5.90	–	–	~ 1.3351 ~ HS6-5-4	~ M4
BOHLER S790 MICROCLEAN	1.29	0.60	0.30	4.20	5.0	–	3.00	6.30	–	–	1.3345 HS6-5-3C	~ M3 Cl.2

BOHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness after tempering
BOHLER S500	max. 280 HBW	1160 – 1180 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	67 – 69 HRc
BOHLER S600	max. 280 HBW	1190 – 1230 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	64 – 66 HRc
BOHLER S705	max. 280 HBW	1190 – 1230 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	64 – 66 HRc
BOHLER S290 MICROCLEAN	max. 350 HBW	1150 – 1210 °C 1150 – 1190 °C	Salt bath, Gas	66 – 70 HRc
BOHLER S390 MICROCLEAN	max. 300 HBW	1150 – 1230 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	65 – 69 HRc
BOHLER S590 MICROCLEAN	max. 300 HBW	1075 – 1180 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	65 – 67 HRc
BOHLER S690 MICROCLEAN	max. 280 HBW	1150 – 1200 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	64 – 66 HRc
BOHLER S790 MICROCLEAN	max. 280 HBW	1050 – 1180 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	64 – 66 HRc

COLD WORK TOOL STEELS



COLD WORK
TOOL STEEL

BOHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN / EN	AISI
BOHLER K100	2.00	0.25	0.35	11.50	–	–	–	–	–	–	1.2080 X210Cr12	~ D3
BOHLER K105	1.60	0.33	0.30	11.50	0.60	–	0.30	0.50	–	–	1.2601 X165CrMoV12	–
BOHLER K107	2.10	0.25	0.38	11.50	–	–	–	0.70	–	–	1.2436 X210CrW12	(~ D6)
BOHLER K110	1.55	0.30	0.38	11.30	0.75	–	0.75	–	–	–	1.2379 X153CrMoV12	D2
BOHLER K245	0.63	1.05	1.05	0.60	–	–	–	–	–	–	1.2101 62SiMnCr4	–
BOHLER K340 ISODUR®	1.10	0.90	0.40	8.30	2.10	–	0.50	–	–	Al, Nb	Patent	–
BOHLER K353	0.82	0.70	0.40	8.00	1.60	–	0.60	–	–	Al	Patent	–
BOHLER K360 ISODUR®	1.25	0.90	0.35	8.75	2.70	–	1.18	–	–	Al, Nb	Patent	–
BOHLER K390 MICROCLEAN®	2.47	0.55	0.40	4.20	3.80	–	9.00	1.00	2.00	–	Patent	–
BOHLER K455	0.63	0.60	0.30	1.10	–	–	0.18	2.00	–	–	1.2550 60WCrV7	~ S1
BOHLER K460	0.95	0.25	1.10	0.55	–	–	0.10	0.55	–	–	1.2510 100MnCrW4	01
BOHLER K490 MICROCLEAN®	1.40	–	–	6.40	1.50	–	3.70	3.50	–	Nb	–	–
BOHLER K890 MICROCLEAN®	0.85	0.55	0.40	4.35	2.80	–	2.10	2.55	4.50	–	Patent	–

BOHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness	Average Rockwell C hardness after tempering at °C						
					100	200	300	400	500	520	550
BOHLER K100	max. 248 HB	940 – 970 °C	Oil, Air (<25 mm Ø), Gas, Salt bath (220 – 250 °C/500 – 550 °C)	57 – 62 HRc	64	62	59	57	–	–	–
BOHLER K105	max. 250 HB	980 – 1010 °C	Oil, Air, Gas, Salt bath (500 – 550 °C)	63 – 65 HRc	64	62	60	58	–	–	–
BOHLER K107	max. 250 HB	950 – 980 °C	Oil, Air, Gas, Salt bath (500 – 550 °C)	64 – 66 HRc	65	63	61	60	–	–	–
BOHLER K110	max. 250 HB	1020 – 1040 °C	Oil, Air, Gas, Salt bath (220 – 250 °C/500 – 550 °C)	58 – 61 HRc	63	61	59	58	–	–	–
BOHLER K245	max. 235 HB	830 – 860 °C	Oil	59 – 62 HRc	61	60	57	51	–	–	–
BOHLER K340 ISODUR®	max. 235 HB	1040 – 1060 °C	Oil, Air, Gas, Salt bath	57 – 63 HRc	see tempering chart						
BOHLER K353	max. 240 HB	1030 – 1060 °C	Oil, Air, Gas, Salt bath	55 – 61 HRc	see tempering chart						
BOHLER K360 ISODUR®	max. 250 HB	1040 – 1080 °C	Oil, Air, Gas, Salt bath	57 – 63 HRc	see tempering chart						
BOHLER K390 MICROCLEAN®	max. 280 HB	1030 – 1180 °C	Oil, Gas	58 – 64 HRc	see tempering chart						
BOHLER K455	max. 225 HB	870 – 900 °C	Oil	53 – 59 HRc	60	59	56	53	–	–	–
BOHLER K460	max. 220 HB	780 – 820 °C	Oil, Salt bath (200 – 250 °C)	63 – 65 HRc	64	62	58	52	–	–	–
BOHLER K490 MICROCLEAN®	max. 280 HB	1030 – 1180 °C	Oil, Gas	58 – 64 HRc	see tempering chart						
BOHLER K890 MICROCLEAN®	max. 280 HB	1030 – 1180 °C	Oil, Gas	58 – 64 HRc	see tempering chart						

HOT WORK TOOL STEELS



HOT WORK
TOOL STEEL

BOHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN / EN	AISI
BOHLER W300 ISO BLOC	0.38	1.10	0.40	5.00	1.30	–	0.40	–	–	–	1.2343 X37CrMoV5-1	H11
BOHLER W302 ISO BLOC	0.39	1.10	0.40	5.20	1.30	–	0.95	–	–	–	1.2344 X40CrMoV5-1	H13
BOHLER W303 ISO DISC	0.38	0.40	0.40	5.00	2.80	–	0.55	–	–	–	1.2367 X38CrMoV5-3	–
BOHLER W320 ISO BLOC	0.31	0.30	0.35	2.90	2.70	–	0.50	–	–	–	1.2365 32CrMoV12-28	~ H10
BOHLER W350 ISO BLOC	0.38	0.21	0.50	4.95	1.75	0.04	0.53	–	–	–	–	–
BOHLER W360 ISO BLOC	0.50	0.20	0.25	4.50	3.00	–	0.60	–	–	–	Patent	–
BOHLER W400 VMR	0.38	0.20	0.30	5.00	1.30	–	0.50	–	–	–	1.2340 ~ X37CrMoV5-1	~ H11
BOHLER W403 VMR	0.38	0.20	0.25	5.00	2.80	–	0.65	–	–	–	~ 1.2367 ~ X38CrMoV5-3	–

BOHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness	Average Rockwell C hardness after tempering at °C					
					400	500	550	600	650	700
BOHLER W300 ISO BLOC	max. 206 HB	1000 – 1040 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	53	54	52	48	38	30
			Air, Gas	50 – 54 HRc						
BOHLER W302 ISO BLOC	max. 206 HB	1020 – 1080 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	54	55	54	50	40	32
			Air, Gas	50 – 54 HRc						
BOHLER W303 ISO DISC	max. 206 HB	1030 – 1080 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	52	54	53	50	44	36
			Air, Gas	50 – 54 HRc						
BOHLER W320 ISO BLOC	max. 206 HB	1010 – 1050 °C	Oil, Salt bath, (500 – 550 °C), Gas	52 – 56 HRc	50	51	52	50	45	36
BOHLER W350 ISO BLOC	max. 240 HB	1020 °C (1010 °C*)	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	–	–	–	–	–	–
			Air, Gas	50 – 53 HRc						
BOHLER W360 ISO BLOC	max. 206 HB	approx. 1050 °C	Oil, Salt bath (500 – 550 °C), Air, Gas	57 – 58 HRc	see tempering chart					
BOHLER W400 VMR	max. 206 HB	980 – 990 °C	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	53	54	52	48	38	30
			Air, Gas	50 – 53 HRc						
BOHLER W403 VMR	max. 206 HB	1020 – 1030 °C	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	52	54	53	50	44	35
			Air, Gas	50 – 53 HRc						

* for big dies



PLASTIC MOULD
STEEL

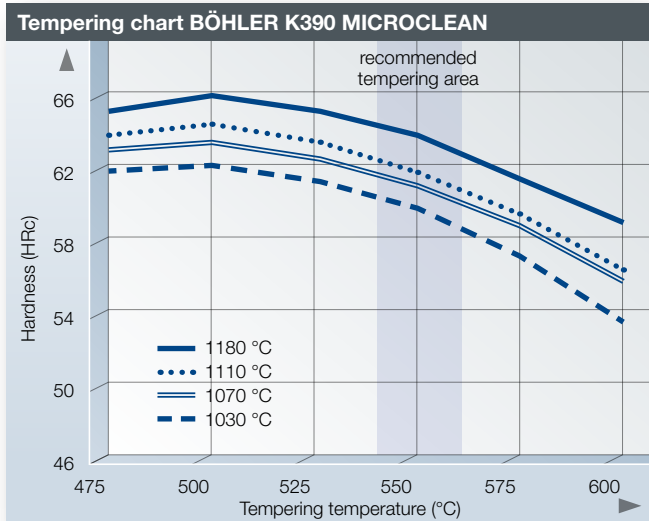
PLASTIC MOULD STEELS

BOHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN / EN	AISI
BOHLER M238	0.38	0.30	1.45	1.95	0.20	1.05	–	–	–	–	1.2738 40CrMnNiMo8-6-4	~ P20
BOHLER M261 EXTRA	0.13	0.30	1.95	0.35	–	3.50	–	–	–	S=0.13, Al=1.75 Cu=1.20	–	–
BOHLER M268 VMR	0.38	0.30	1.50	2.00	0.20	1.10	–	–	–	–	~ 1.2738	~ P20
BOHLER M303 ISOPLAST*	0.28	0.25	0.65	14.50	0.95	0.86	–	–	–	+N	~ 1.2316 ~ X38CrMo16	–
BOHLER M310 ISOPLAST*	0.38	0.70	0.43	14.25	–	–	0.20	–	–	–	~ 1.2083 ~ X42Cr13	~ 420
BOHLER M315 EXTRA	0.05	0.30	0.95	12.60	–	0.45	–	–	–	S = 0.10 Cu = 0.40	Patent	–
BOHLER M333 ISOPLAST*	0.28	0.30	0.30	13.50	–	–	–	–	–	+N	Patent	–
BOHLER M340 ISOPLAST*	0.54	0.45	0.40	17.25	1.10	–	0.10	–	–	+N	Patent	–
BOHLER M390 MICROCLEAN	1.91	0.60	0.30	20.0	1.00	–	4.00	0.60	–	–	Patent	–

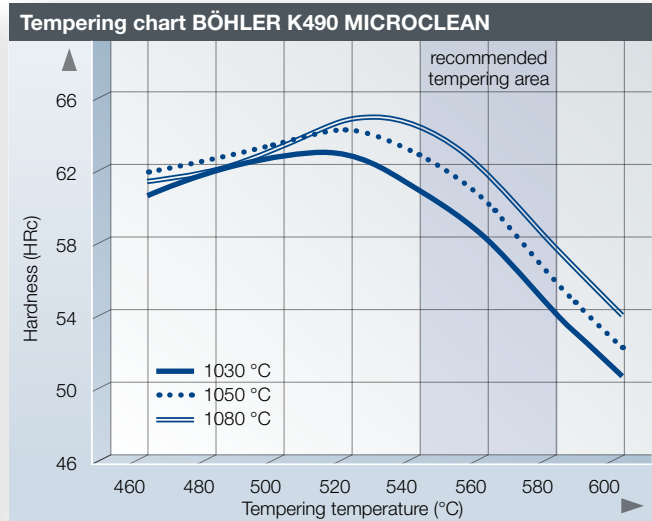
BOHLER grade	Hardness after annealing	Hardening temp. Quenchant	Supplied condition N/mm ²	Average surface hardness after hardening Rockwell C	Normal assembly condition
BOHLER M238	–	840 – 860 °C Oil	approx. 1000	–	hardened and tempered
BOHLER M261 EXTRA	approx. 30 HRc solution annealed	560 – 580 °C Air	–	approx. 40	solution annealed and precipitation hardened
BOHLER M268 VMR	–	840 – 880 °C Oil	approx. 1200	–	hardened and tempered
BOHLER M303 ISOPLAST*	–	1000 – 1020 °C / Oil, Gas, Salt bath (400 – 450 °C)	900 - 1120	– 48 – 53 Oil	hardened and tempered
BOHLER M310 ¹⁾ ISOPLAST*	max. 200 HBW	1000 – 1050 °C Gas, Salt bath, Oil	–	–	hardened and tempered
BOHLER M315 EXTRA	–	–	approx. 1000	–	hardened and tempered
BOHLER M333 ¹⁾ ISOPLAST*	max. 220 HBW	980 – 1020 °C Oil, Gas	–	48 – 52	hardened and tempered
BOHLER M340 ¹⁾ ISOPLAST*	max. 260 HBW	980 – 1000 °C Oil, Gas	–	53 – 58	hardened and tempered
BOHLER M390 ¹⁾ MICROCLEAN	max. 280 HBW	1120 – 1180 °C Oil, Gas, Salt bath	–	58 – 60	hardened and tempered

¹⁾ for certain applications sub zero treatment is recommended for dimensional stability

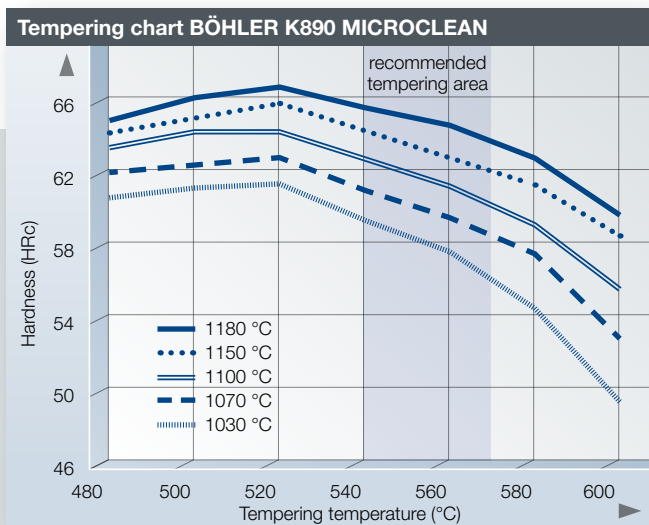
TEMPERING CHARTS



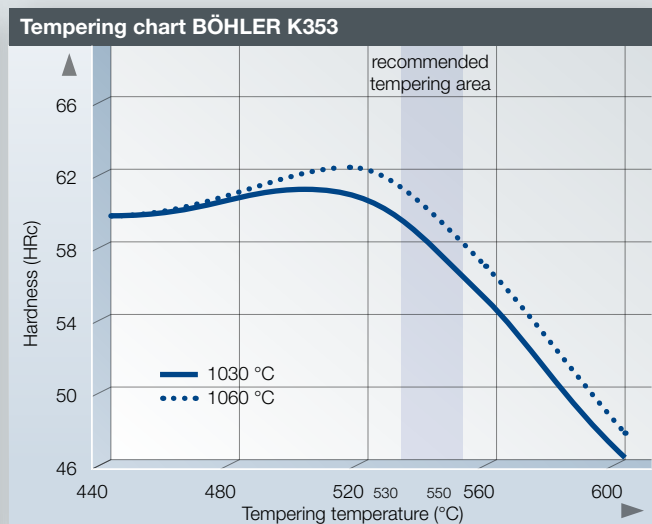
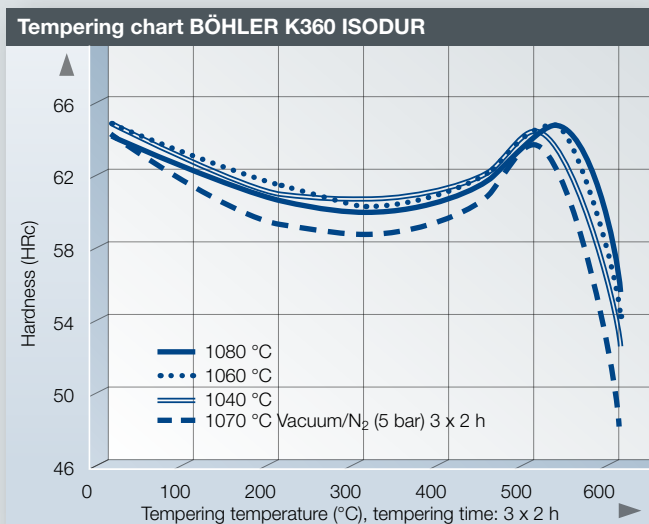
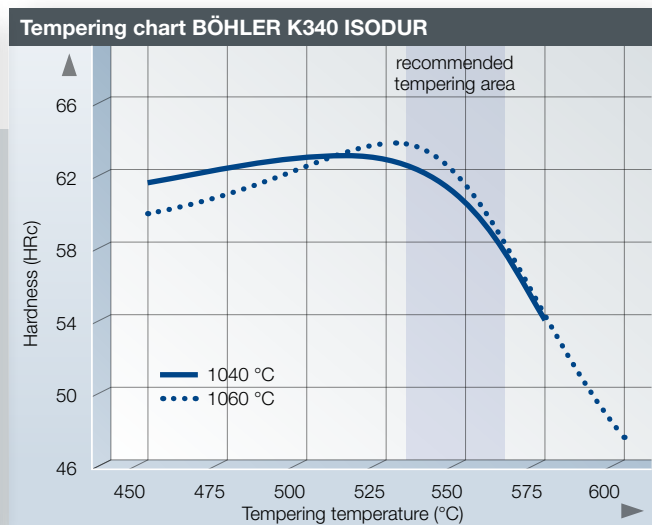
hardened in vacuum furnace: N₂ cooling, 5 bar



Sample size: round 35 x 15 mm



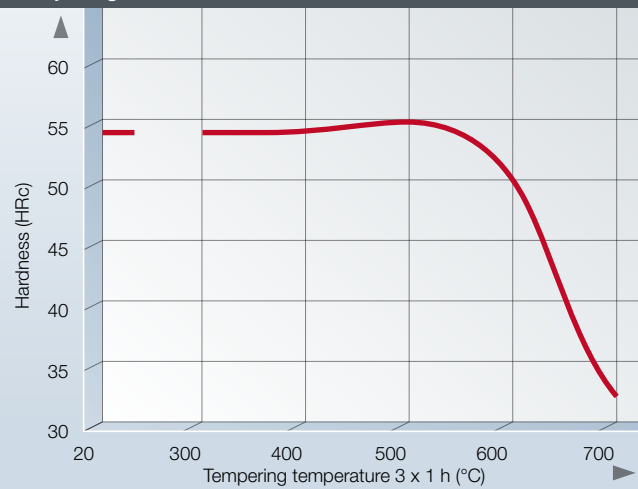
hardened in vacuum furnace: N₂ cooling, 5 bar



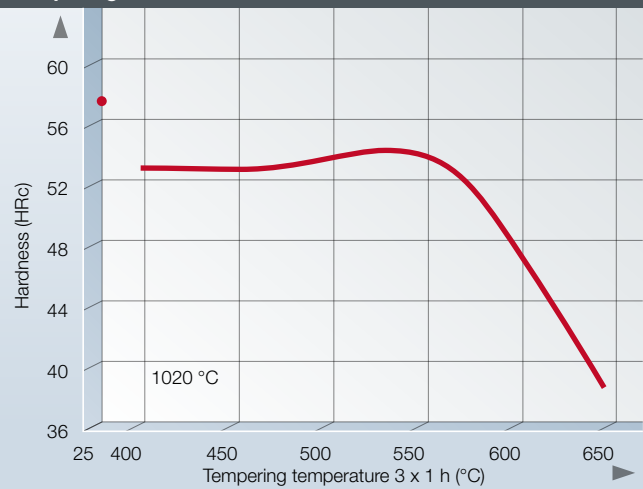
One of the remarkable features of BÖHLER K490 MICROCLEAN is its flexibility in heat treatment:

- We recommend the same hardening temperatures as with widely used cold work tool steels (e.g. 1.2379/D2)
- Very stable mechanical properties, regardless of the hardening temperature (1030 – 1080 °C)

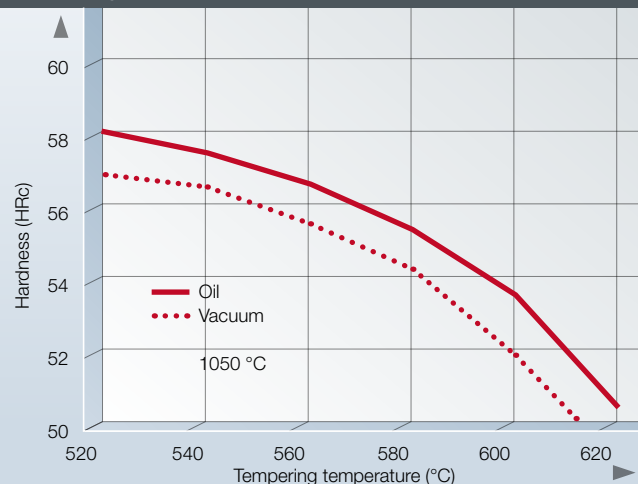
Tempering chart BÖHLER W302 ISOBLOC



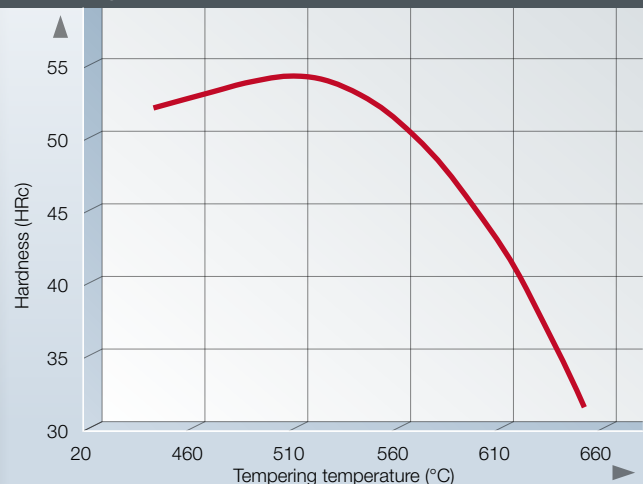
Tempering chart BÖHLER W350 ISOBLOC



Tempering chart BÖHLER W360 ISOBLOC



Tempering chart BÖHLER W403 VMR



SPECIAL MATERIALS



AEROSPACE

HIGH FLYING MATERIALS

Materials for the aircraft industry

Faster, lighter, further

– are terms of our times which must be taken literally, especially in the aerospace industry. This demands the work of the best. Fulfilling these requirements demands everything of materials. BÖHLER provides the materials that aerospace engineers need – in the grade and dimension they want.

Expertise in all material matters

Main system approvals

AS9100, ISO9001

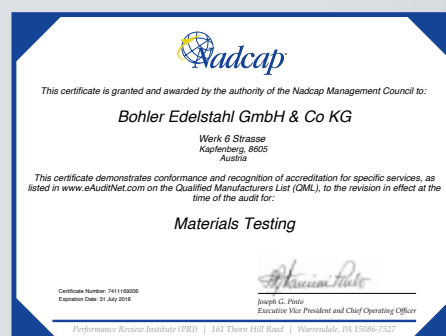
- GE AE S1000
- PWA 300
- Rolls Royce SABRE
- Snecma
- MTU
- ITP
- Agusta (acc. AQM-002)
- Airbus Germany (acc. QVA-V06-02-00)
- Airbus UK Ltd. (acc. AUK/SA/001-3)
- BAE Systems (operations) Ltd.
- BAE Systems Regional Aircraft (RALOA/00503/3)
- Böhler Schmiedetechnik
- Boeing (D1-4426)
- Bombardier Aerospace (Code 1013)
- Hawker Beechcraft Corp. (Code QCOO Rev.F)
- Korean Air
- Messier Dowty (SAFRAN Group)
- NHBB
- Westland Helicopters
- SKF Aeroengines France (SNFA)
- GKN Aerospace
- Goodrich Aerostructures

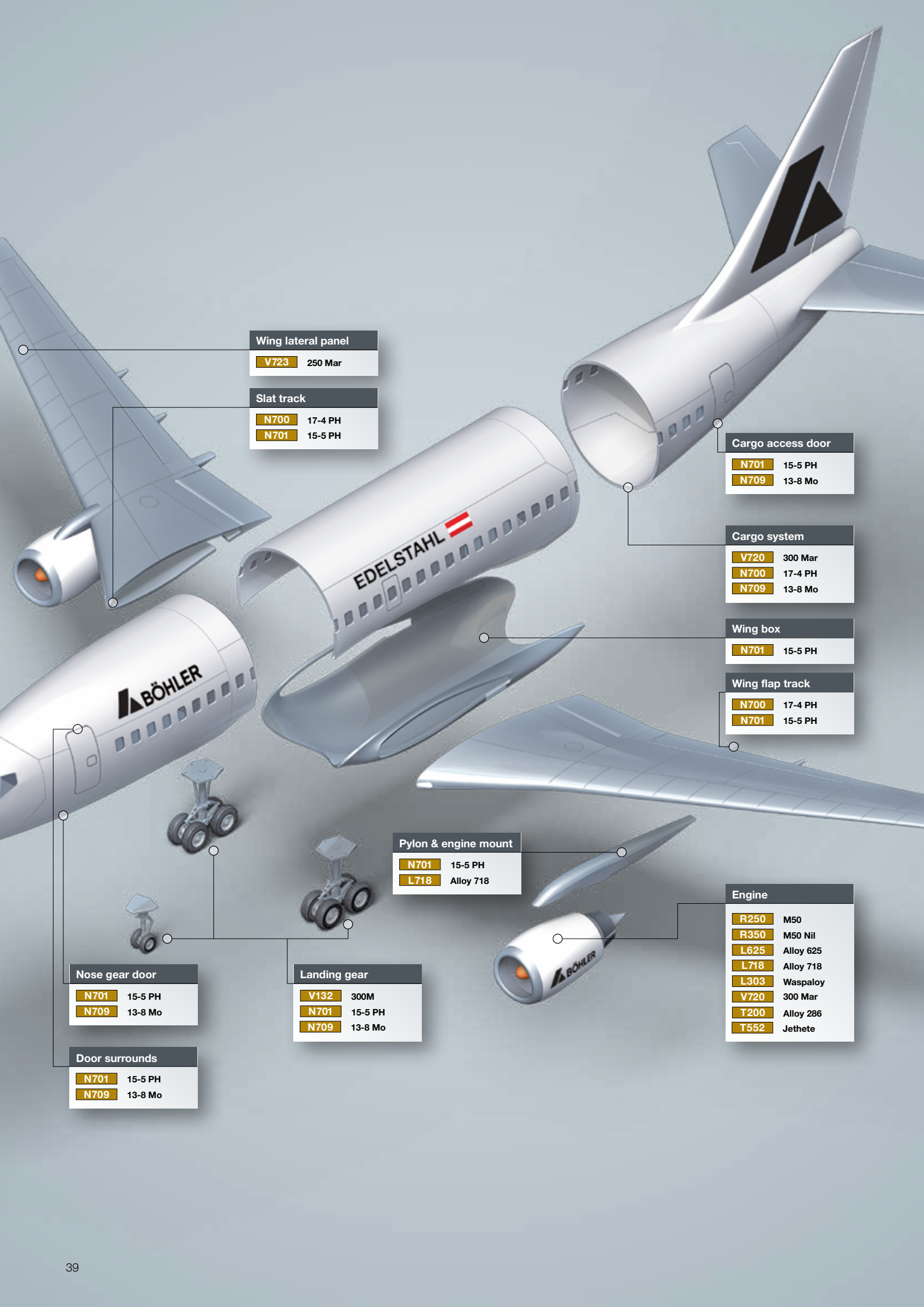
Main Laboratory Approvals

- NADCAP Chemical, Mechanical, Corrosion Testing, Metallography and Hardness, Heat treatment
- GE Aero Engines S400
- Pratt & Whitney LCS/MCS MCL F17
- Snecma Moteurs FAL n°310 acc. PRO 0430
- Rolls Royce MSRR 9951
- Airbus France MM 049
- Boeing D1-4426

Main NDT Approvals

- NADCAP AMS-STD 2154
- GE Aero Engines P3TF34
- Pratt & Whitney SIM 14, SIS 45
- Snecma Moteurs DMC 0022
- Rolls Royce RRP58002
- Airbus UK APB 6-5232
- Boeing D1-4426





Wing lateral panel	
V723	250 Mar

Slat track	
N700	17-4 PH
N701	15-5 PH

Cargo access door	
N701	15-5 PH
N709	13-8 Mo

Cargo system	
V720	300 Mar
N700	17-4 PH
N709	13-8 Mo

Wing box	
N701	15-5 PH

Wing flap track	
N700	17-4 PH
N701	15-5 PH

Pylon & engine mount	
N701	15-5 PH
L718	Alloy 718

Engine	
R250	M50
R350	M50 Nil
L625	Alloy 625
L718	Alloy 718
L303	Waspaloy
V720	300 Mar
T200	Alloy 286
T552	Jethete

Nose gear door	
N701	15-5 PH
N709	13-8 Mo

Landing gear	
V132	300M
N701	15-5 PH
N709	13-8 Mo

Door surrounds	
N701	15-5 PH
N709	13-8 Mo

SPECIAL MATERIALS



POWER
GENERATION

POWER FOR GENERATIONS

Materials for the power generation industry

Innovation is the power for high performance

As an energy production company you demand the highest standards from our steels. That makes us partners in performance. The high-end field in particular is where we can show our advantage in technology at its best; where we can put forward our metallurgical know-how and highlight our 120 years of experience. It is precisely these demands that inspire us to carry on research and constantly improve the properties of our steels.

Your interests and our will to continuous development, has made us the clear-cut number one in the world of melting and remelting technology. We are well aware that this market position is not something we should ever take for granted. It is a daily reminder for the best minds working under the best production conditions in revolutionary production facilities to go beyond the confines of what is feasible.

Meeting the energy of the society in which we live is a challenge we face up to on a daily basis. Economically and ecologically. It's a challenge we would like to take up with you at our side.

The best test results

The BÖHLER testing laboratory has been accredited by the performance review institute ISO 17025 and NADCAP to conduct tests for the zero tolerance field of aviation as well. This means that all of the mechanical-technological and metallographical tests carried out not only meet the simulated demands of reality but exceed them beyond expectations!

Ni-base alloys

BÖHLER L080A	Alloy 80A
BÖHLER L263	Alloy 263
BÖHLER L617	Alloy 617
BÖHLER L625	Alloy 625
BÖHLER L718	Alloy 718
BÖHLER L750	Alloy X750
BÖHLER L901	Alloy 901

Special steels

BÖHLER N700	17-4 PH
BÖHLER T504	422
BÖHLER T550	X20CrMoV12-1
BÖHLER T552	Jethete
BÖHLER T560SB	403 CB+
BÖHLER T651	X20Cr13
BÖHLER T655SC	403/410

SPECIAL MATERIALS



OIL, GAS & CPI

HIGHEST PERFORMANCE

Materials for oil & gas applications

Quality knows no compromises

More efficient, safer – These are concepts to which great significance is assigned particularly when it comes to the production of energy. Covering daily energy needs while simultaneously practicing environmental conservation is a challenge for engineers and their materials alike.

For generations BÖHLER has been facing up to this challenge by developing and producing materials of the highest metallurgical purity for use in extreme environments. The material properties there are as varied as the manufacturing possibilities at BÖHLER. As one of the few producers of steel we at BÖHLER have all of the melting and remelting facilities (ESR, PESR, VAR) here at our disposal.

Expertise in all material matters

Main Quality System approvals

- ISO 9001
- EN 9100

Main Laboratory Approvals

- bmfwf, EN ISO/IEC 17025
- PRI Performance Review Institute (NADCAP)

Main Material Approvals:

- NORSOK M-650, Teknologisk Institut Certification AS
- Statoil Hydro, rolled and forged bars in ASTM A276 grade, Norsok Standard M-650
- Lloyds Register, Steelmaking and bars, Forgings in carbon, carbon-manganese and alloy steel
- PRI (NADCAP), AC7114, AC7114/3
- TÜV-Süd, AD2000 Instruction W0/TRD100/HP0, Pressure equipment directive 97/23/EG



Ni-Superalloys

BÖHLER L625

BÖHLER L718 API

BÖHLER L925

Super-Duplex

BÖHLER A911SA

BÖHLER A913

Austenitics

BÖHLER P511

BÖHLER T200

Heat treatable

BÖHLER N400

BÖHLER N404



BÖHLER L718
AMPO



BÖHLER N700
AMPO



BÖHLER W722
AMPO

SCIENCE! NO FICTION

BÖHLER Edelstahl has expanded the portfolio and offers three **powders for additive manufacturing** with the brand **BÖHLER AMPO**. Our customer benefit from:

PRODUCT RANGE

Atomization of BÖHLER standard brands (theoretical selection from 250 steel brands). **Customization of alloys** with small scale production plant and metallurgical expertise.

STATE OF THE ART TECHNOLOGY

Vacuum induction melting and atomization under inert gas **ensure the highest product quality**. **Powder is produced on latest atomization techniques** and tested in-house.

HIGHEST PRODUCT QUALITY

Depending on the steel grade and customer requirements, raw materials **molten under vacuum or remolten** can be used. This ensures the highest quality standards and minimizes undesired impurities.

PARTICLE SIZE DISTRIBUTION

Depending on the requirements of the AM process used, **we can provide the appropriate particle fraction in a range from 15–150 µm**.

TEST LABORATORY / ANALYSES

BÖHLER Edelstahl's **modern in-house laboratories** provide our production facilities with vital information and product parameters for process control and product certification in accordance with test standards and customer specifications.

RECYCLING

We support our customers in powder recycling to contribute to **greater efficiency**.

GLOBAL SALES NETWORK

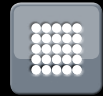
Optimal availability through storage at the central warehouse in Kapfenberg and in sales warehouses worldwide as needed. **Short delivery times combined with high delivery reliability**.





BÖHLER
EDELSTAHL

AMPO



**Additive
Manufacturing
Powder**

THE NEXT GENERATION OF COMPONENT MANUFACTURING





BÖHLER AMPO TECHNICAL DATA

We offer powders with the right properties for every application and printing technology. In our **own development and test center in Düsseldorf** – the voestalpine Additive Manufacturing Center – we produce test objects with 3D printing in order to acquire experience and explore new application areas for additive manufacturing of components.

AMPO Grade	Particle size distribution* [µm]			
	15–45 (e.g. laser powder bed fusion)		45–150 (e.g. direct laser deposition)	
	Flowability* [s]	Apparent density* [g/cm ³]	Flowability* [s]	Apparent density* [g/cm ³]
BÖHLER L718 AMPO	<18	3.96	<21.5	3.5
BÖHLER N700 AMPO	<19	3.96	<21.5	3.4
BÖHLER W722 AMPO	<18	3.90	<22.0	3.3

* Measurement of particle size distribution is based on ISO 13322-2 (Dynamic image analysis methods); Flowability and apparent density are based on DIN EN ISO 4490 resp. DIN EN ISO 3923-1.

Your contact for further information:
info-powder@bohler-edelstahl.at
exportsales@bohler-international.com

AMPO



Additive
Manufacturing
Powder

BOHLER L718 DIN 2.4668 (capable to meet the chemistry of API and AMS)
AMPO

Chemical Composition [wt. %]

Element	C	Ni	Cr	Mn	P	S	Si	Mo	Fe	Cu	Co	Al	Nb	Ti
min	0.02	50	17	-	-	-	-	2.8	remainder	-	-	0.3	4.7	0.65
max	0.08	55	21	0.35	0.015	0.015	0.35	3.3	remainder	0.3	1	0.7	5.5	1.15

BOHLER N700 DIN 1.4542 / 17-4PH (capable to meet chemistry of AMS)
AMPO

Chemical Composition [wt. %]

Element	C	Ni	Cr	Mn	P	S	Si	Mo	Cu	Nb
min	-	3	15	-	-	-	-	-	3	5xC
max	0.07	5	17	1.5	0.04	0.015	0.7	0.6	5	0.45

BOHLER W722 DIN 1.2709 / ~ MS1 / Marage 300
AMPO

Chemical Composition [wt. %]

Element	C	Si	Mn	P	S	Cr	Mo	Ni	Ti	Co
min	-	-	-	-	-	-	4.5	17	0.8	8.5
max	0.03	0.1	0.15	0.01	0.01	0.25	5.2	19	1.2	10.0

Order quantity 10 kg minimum

Particle size distribution 15 to 150 µm



SPECIAL STEEL FOR THE WORLD'S TOP PERFORMERS

Your partner: _____

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Fax: +43-50304 70-23308
E-Mail: exportsales@bohler-international.com
www.bohler-international.com

