BÖHLER

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

voestalpine High Performance Metals International GmbH
www.bohler.at/Export

voestalpine
ONE STEP AHEAD.

BÖHLER SPECIAL STEEL – 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 **voestalpine 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.

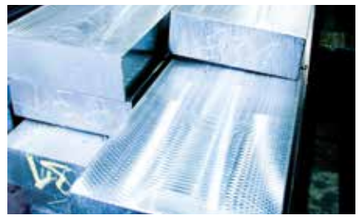
With an international sales and service network we are always close to our customers – worldwide. **Welcome to voestalpine BÖHLER.**

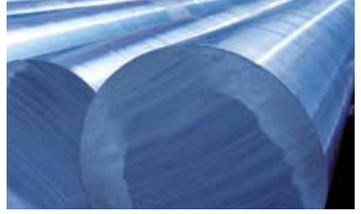
Special steels are a fundamental part of our modern world. They will continue to form the basis for economic success and innovation in many important sectors of industry in the future – integrated as components or serving as tools. voestalpine BÖHLER Edelstahl is one of the driving forces and pioneers behind this progress.

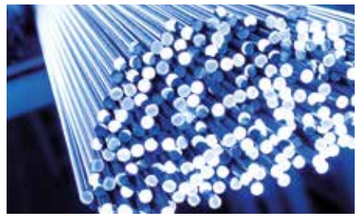
TRENDSETTING TECHNOLOGIES FOR HIGHEST QUALITY


Forged billets, bright ground


Bar steel ground with bevelled ends

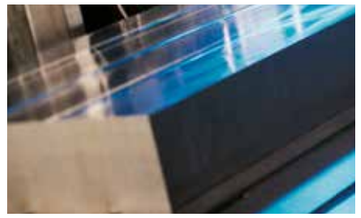

Flat steel milled

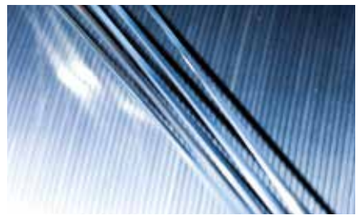

Bar – peeled + ground

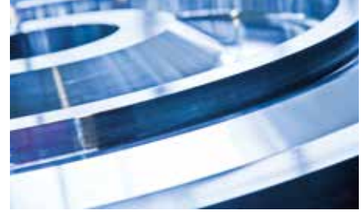

Bright steel – peeled – polished


Flat steel – precision ground


Bar – peeled – polished


Block sawn + milled


Precision flat wire

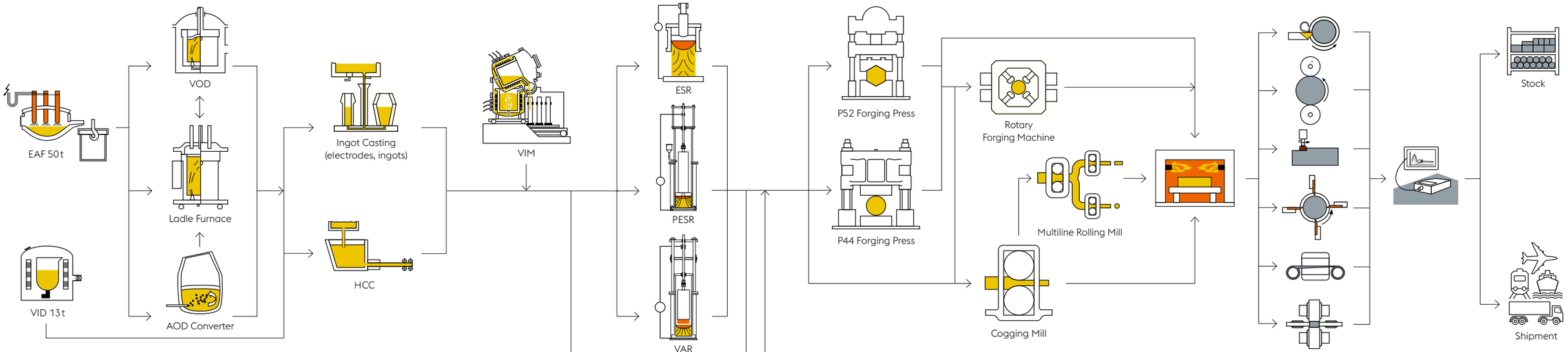

Open die forge


Flat steel

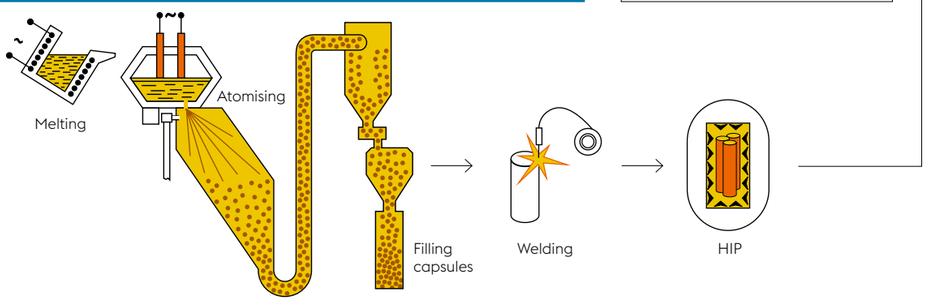

Wire / rolled

FLOW OF MATERIAL

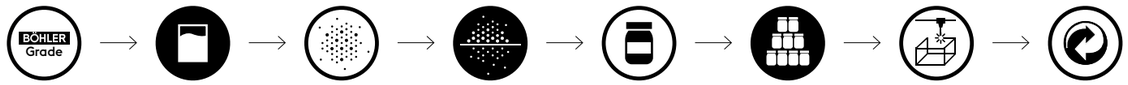
MELTING | SECONDARY METALLURGY | CASTING | SPECIAL MELTING | REMELTING | ROLLING AND FORGING | HEAT TREATMENT | MACHINING | TESTING | DISPATCH



POWDER METALLURGY



AMPO



BÖHLER SPECIALTIES

HIGH SPEED STEEL · POWDER METALLURGY · COLD WORK TOOL STEEL · HOT WORK TOOL STEEL · PLASTIC MOULD STEEL · AMPO · SPECIAL MATERIALS AEROSPACE · SPECIAL MATERIALS AUTOMOTIVE · SPECIAL MATERIALS OIL, GAS & CPI · SPECIAL MATERIALS POWER GENERATION · SEMI FINISHED PRODUCTS · OPEN DIE FORGE

THESE BRAND NAMES REPRESENT HIGHEST STEEL QUALITY:

MICROCLEAN®
Powder metallurgical steels

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

ISOPLAST®
Plastic mould steels in ESR quality

ISODUR®
Cold work tool steels in ESR quality

ISORAPID®
High speed steels in ESR quality

ISOBLOC®
Hot work tool steels in ESR quality with special heat treatment

ISODISC®
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

PRODUCTS

BAR STEEL rolled

round:		12.5 – 150 mm
square:		15 – 130 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 mm	70 mm minimum
	1600 mm	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
ECOBLANK	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, premachined, 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, oil & gas industry, energy engineering, medical technology

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

COLD WORK TOOL STEEL

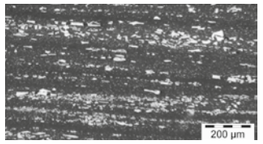
COLD WORK TOOL STEELS

3 QUALITY LEVELS – 3 TECHNOLOGIES

CONVENTIONAL PRODUCTION

The products produced in the electric arc furnace are described as conventionally molten materials and represent the „basic materials“ for the usual stress with the following main properties:

» Carbide distribution in lines
» Sufficient degree of purity

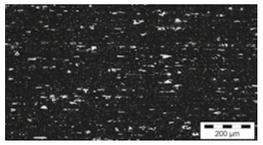


Microstructure of conventional 12% Cr steel

ESR / PESR PRODUCTION

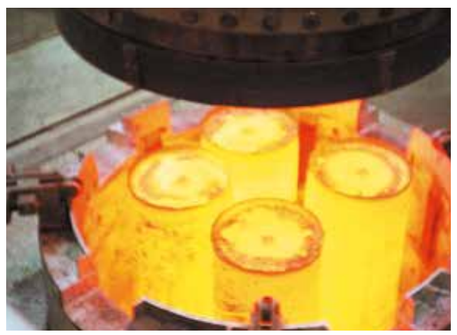
By using the ESR or PESR method, products with improved properties can be produced. The use of remelted materials leads to better tool life and is achieved by:

» High degree of purity
» Low segregations
» The production of large rod dimensions with the same carbide distribution
» Constant size alteration
» Improved toughness



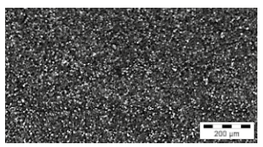
Microstructure of 8% Cr steel in ESR quality

POWDER METALLURGICAL PRODUCTION



In order to meet the highest demands in the different processing methods, materials which are produced by powder metallurgy are increasingly used. These materials offer properties at a demanding, high level:

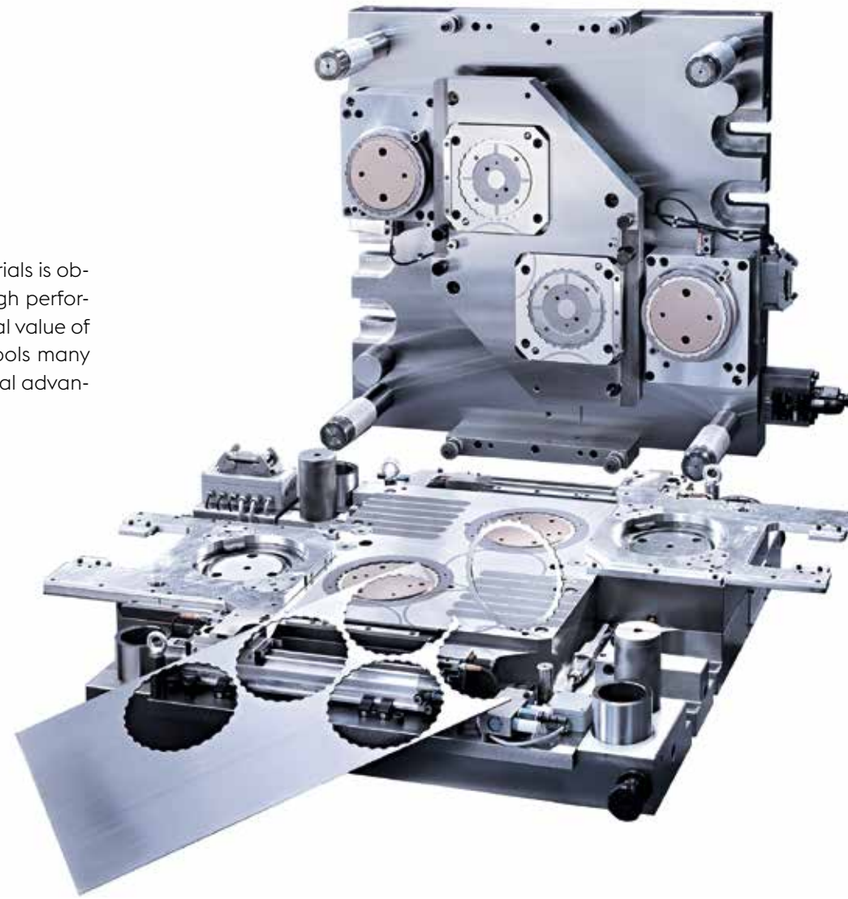
» Free from segregations
» Finest carbide distribution
» Homogeneous properties
» High wear resistance
» Very good dimensional stability
» High pressure resistance
» High toughness with high hardness



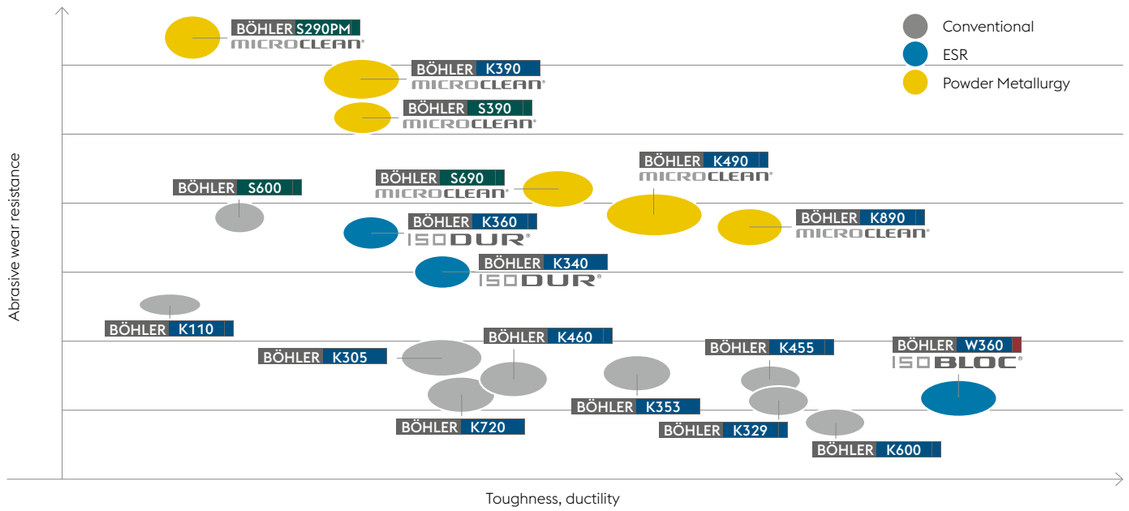
Microstructure PM materials

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®

THE ALL-ROUNDER FOR HIGH DEMANDS

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

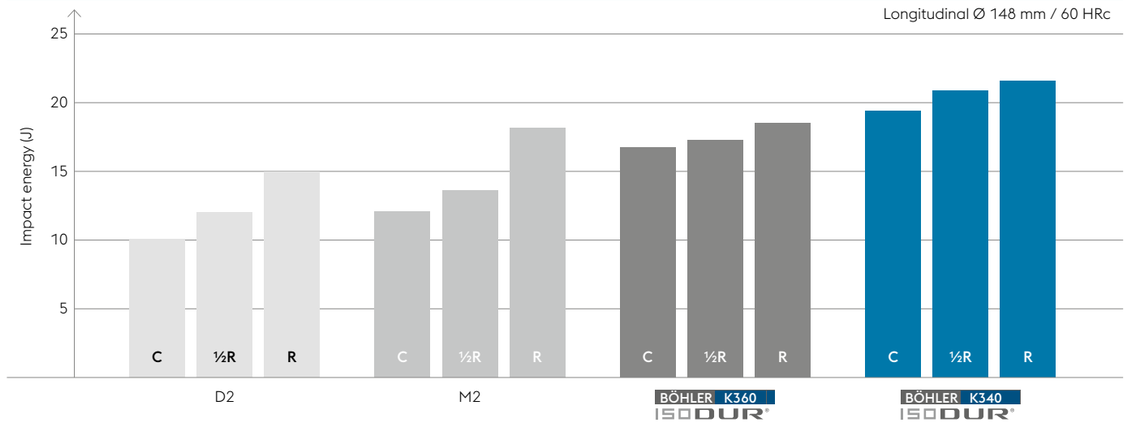
» 8% Cr-steel with a modified chemical composition
» High toughness and outstanding compressive strength
» Excellent adhesive wear resistance thanks to special alloy additions
» High abrasive wear resistance
» Very good resistance to tempering
» Secondary-hardening cold work tool steel with good dimensional 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

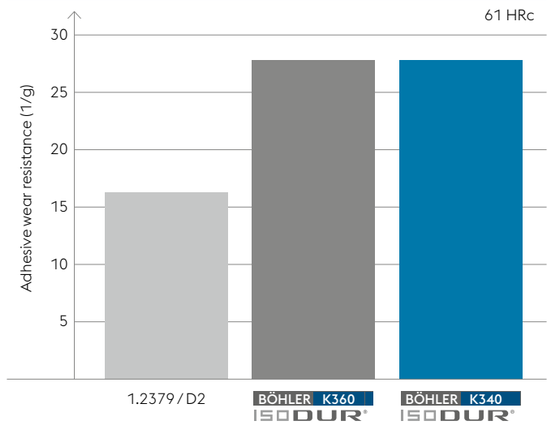
» Forming and punching tools e.g. dies and punches
» Cold working tools e.g. tools for deep drawing or extrusion
» Coining tools
» Bending tools
» Thread rolling tools
» Industrial knives
» Machine components (e.g. guide rails)

BÖHLER K340 – THE PERFECT MATERIAL FOR MINT COINING

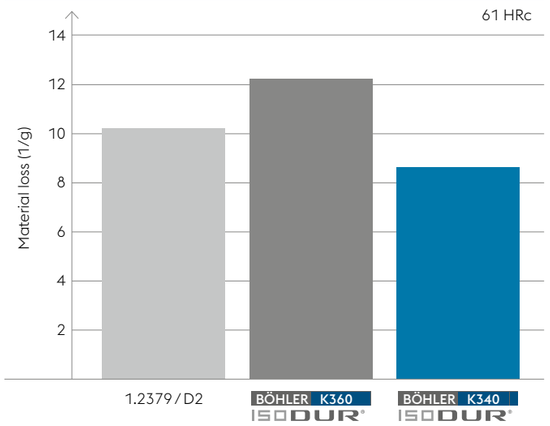
Toughness (unnotched)



Adhesive wear resistance



Abrasive wear resistance



BÖHLER K490 MICROCLEAN®

FOR DEMANDING APPLICATIONS

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 & cost-efficiency
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.

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.

FIELDS OF 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

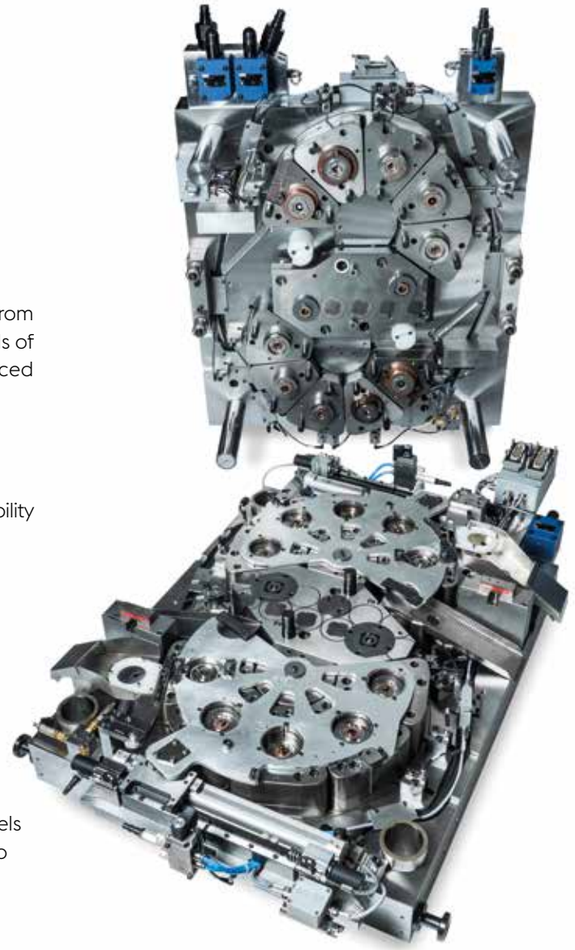
Industrial knives

Plastic processing industry

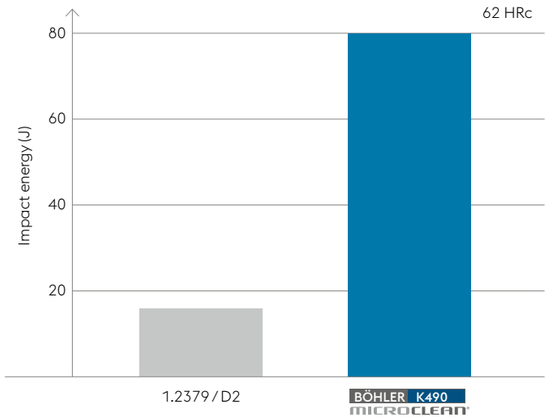
Saves time and money
Speed is vital in component manufacture. Process time from prototype to finished tooling is drastically reduced. Tools of complicated design and high quality can be produced quickly and efficiently.

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

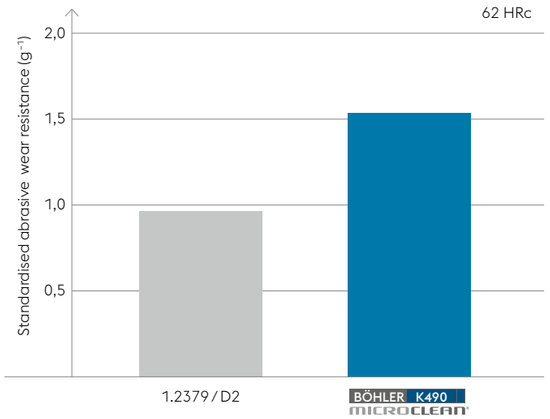


Toughness (unnotched)

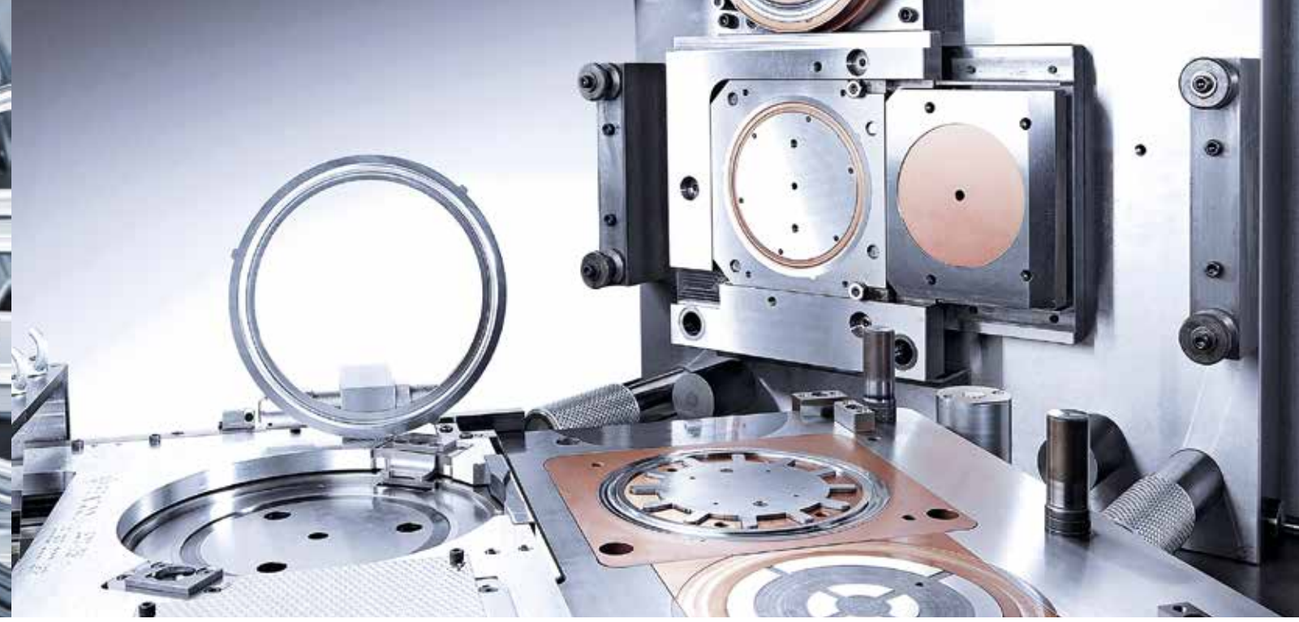


Samples taken from a rolled steel bar in longitudinal direction, heat treated at a cooling rate of: λ ≤ 0,5
Primary material size: round 35 mm
Sample size: 10 x 7 x 55 mm
Heat treatment parameters for:
BÖHLER K490 MICROCLEAN: 1080 °C, 3 x 2 h, 560 °C
1.2379/D2: 1070 °C, 3 x 2 h, 520 °C

Abrasive wear resistance

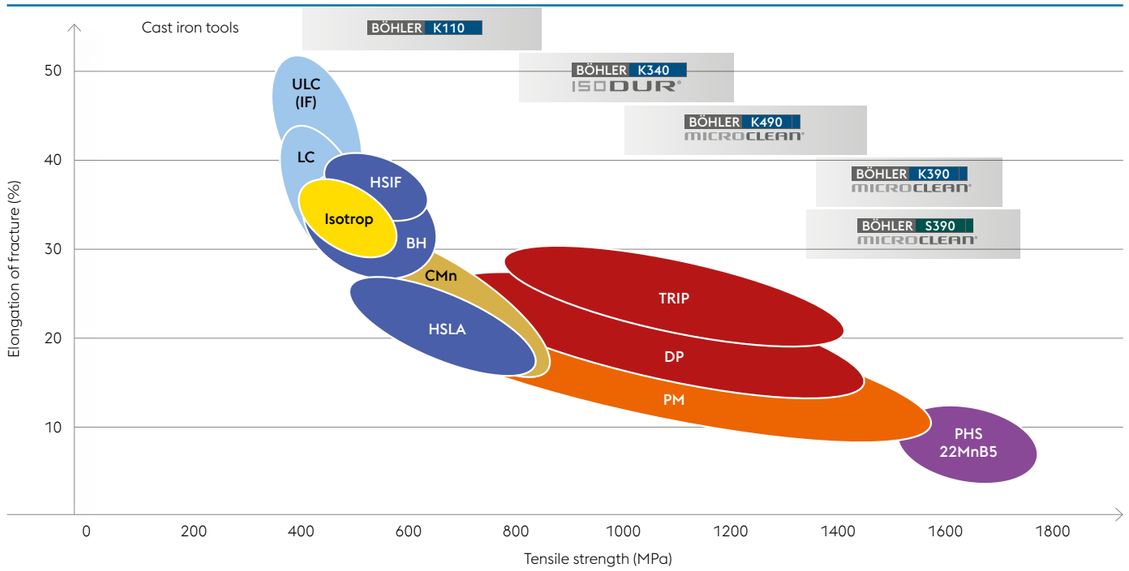


Determined by the Rubber-Wheel-Dry-Sand test according to ASTM G65
Samples taken from a of rolled steel bar in lateral direction, center
Primary material size: round 70 mm
Sample size: 60 x 25 x 8 mm, Ra < 0,8 µm
Heat treatment parameters for:
BÖHLER K490 MICROCLEAN: 1080 °C, 3 x 2 h, 560 °C
1.2379/D2: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



MATERIALS USED FOR CUTTING, PUNCHING AND BLANKING OF HIGH-STRENGTH AND ULTRAHIGH-STRENGTH SHEETS

Tool steels – sheet materials



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		

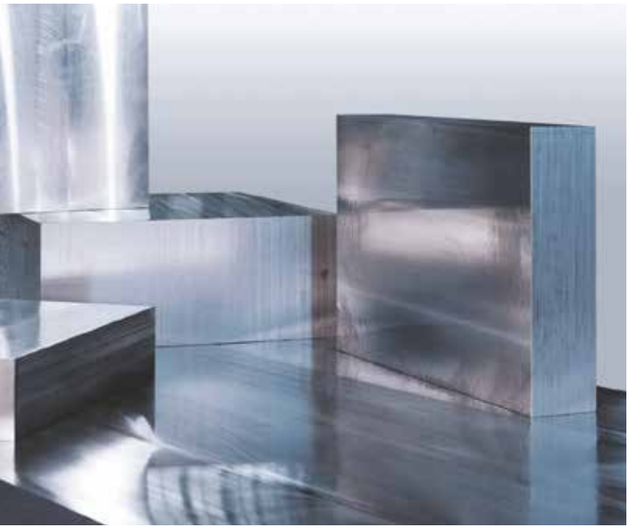
Evaluation of material properties in blanking and cutting applications (please note: The comparison is strongly dependent on the heat treatment conditions and applicable for the brands within this table only):

BÖHLER grade	Wear resistance abrasive	Wear resistance adhesive	Toughness	Compressive strength	Dimensional stability in heat treatment
BÖHLER K100	★★★	★	★	★	★★
BÖHLER K110	★★★	★	★	★★	★★
BÖHLER K305	★	★	★★★★	★	★
BÖHLER K340 ISODUR	★★★	★★★★	★★★	★★★	★★★
BÖHLER K353	★★	★★★	★★★★★	★★	★★
BÖHLER K360 ISODUR	★★★★	★★★★	★★	★★★	★★★
BÖHLER K390 MICROCLEAN	★★★★★	★★★★★	★★★★	★★★★	★★★★
BÖHLER K455	★	★	★★★★★	★	★
BÖHLER K490 MICROCLEAN	★★★★	★★★★	★★★★★	★★★	★★★★
BÖHLER K600	★	★	★★★★★	★	★
BÖHLER K890 MICROCLEAN	★★★	★★★	★★★★★	★★★	★★★★
BÖHLER S600	★★	★★	★	★★★	★★
BÖHLER S630	★★	★★★	★★	★★★	★★★
BÖHLER S290 MICROCLEAN	★★★★★	★★★★★	★★	★★★★★	★★★★
BÖHLER S390 MICROCLEAN	★★★★★	★★★★	★★★	★★★★	★★★★
BÖHLER S690 MICROCLEAN	★★★★	★★★	★★★★	★★★	★★★★
BÖHLER W360 ISOBLOC	★	★	★★★★★★	★	★★

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

HOT WORK TOOL STEEL

HOT WORK TOOL STEELS



FOR THE MOST DEMANDING TOOL REQUIREMENTS

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.

Hot wear resistance, hot toughness, hot strength, retention of hardness, thermal shock resistance as well as thermal conductivity are characterized not only by the compostion 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.

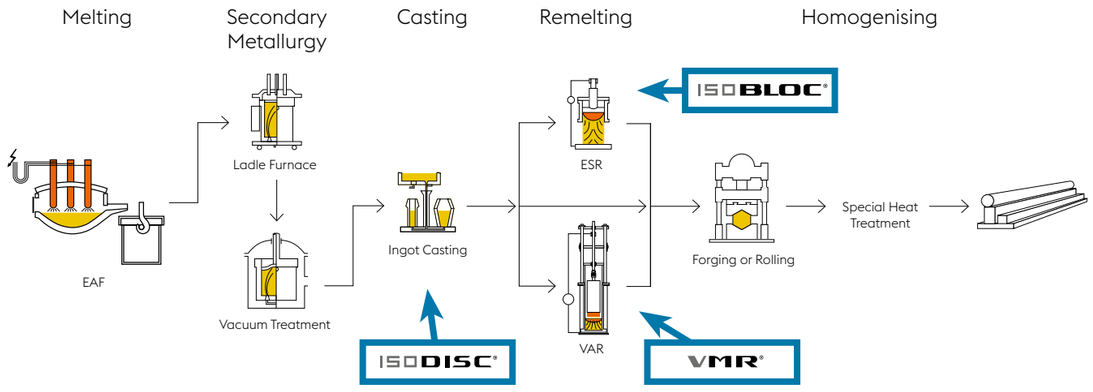
3 qualities for special applications:

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

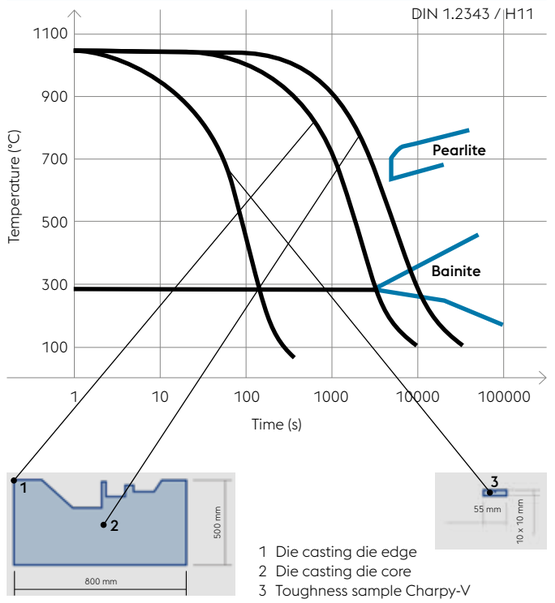
In order to achieve high toughness in tools, the cooling rate from the hardening temperature is of major importance. Cooling rate is primarily dependent on the tool size. With increasing tool thickness, resulting in a reduced quenching rate, a change of microstructure occurs, leading to a significant decrease of toughness.

NADCA material approval
- BÖHLER W300 ISOBLOC
- BÖHLER W302 ISOBLOC
- BÖHLER W350 ISOBLOC
- BÖHLER W400 VMR
- BÖHLER W403 VMR

Damage mechanisms
- Thermal fatigue crack networks
- Erosion
- Gross cracking
- Stress cracks
- Chemical attack

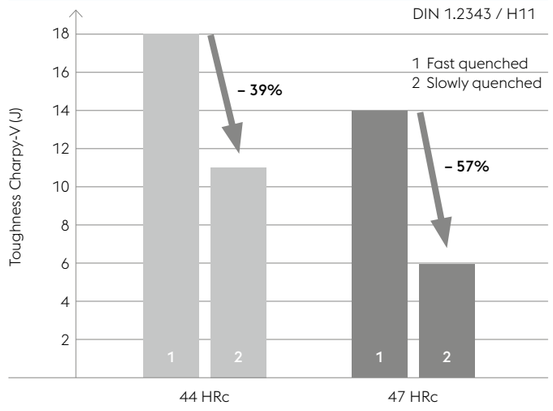
Tool steel properties
- Hardness «
- Strength «
- Toughness «
- Ductility «
- Thermal conductivity «

Cooling chart

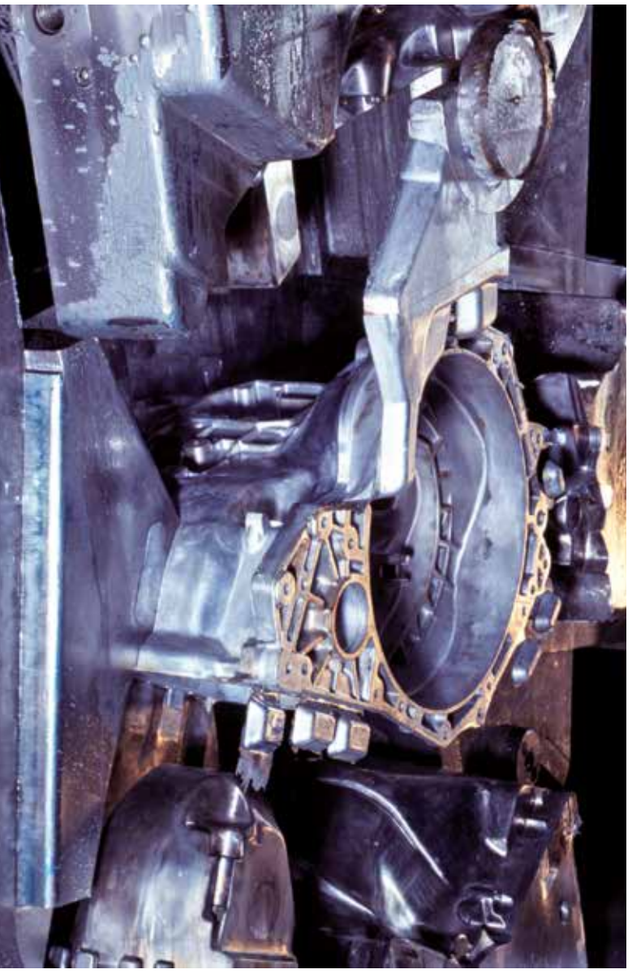


1 Die casting die edge
2 Die casting die core
3 Toughness sample Charpy-V

Toughness comparison



BÖHLER W350
ISOBLOC®



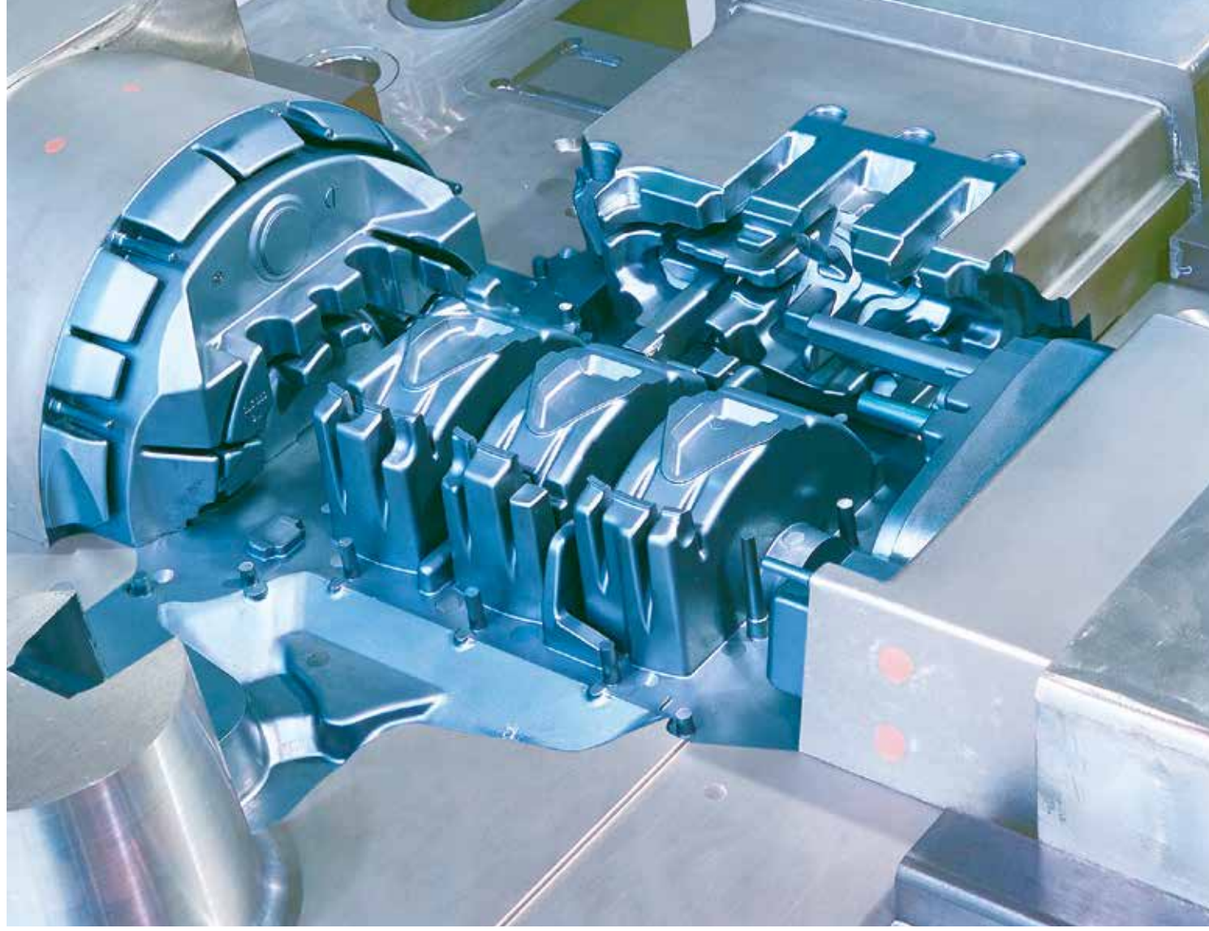
THE MATERIAL FOR HUGE TOOLS

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

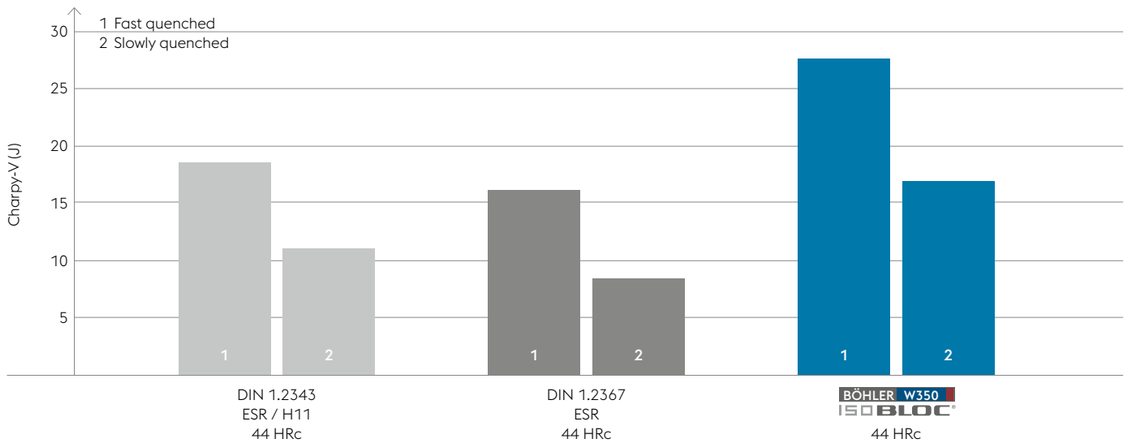
A balanced alloy composition ensuring high toughness even in large tools and an improved thermal stability opts for an optimal hardness/strength-toughness/ductility ratio (elongation after fracture and percentage reduction of area after fracture) tailor-fit to every application.

A pressurized remelting process (pressure ESR) coupled with optimized forging technology in three dimensions guarantees a high degree of homogeneity of the mircrostructure 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

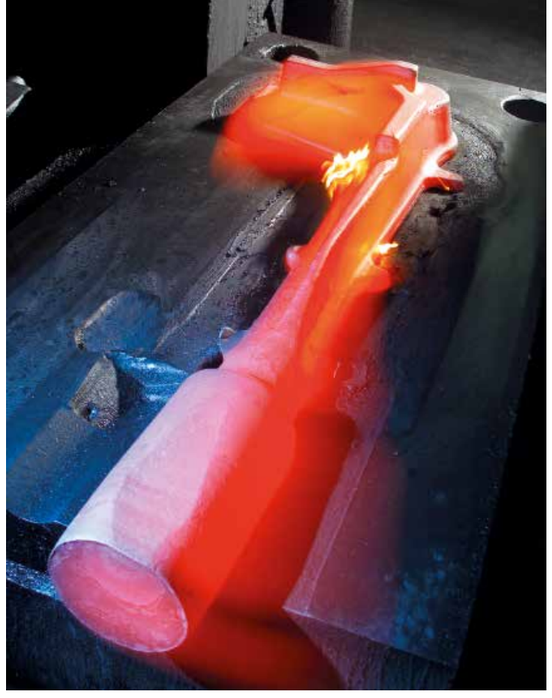


The reduced cooling velocity leads to a significant decrease of toughness. If the hardness is increased, the decrease in toughness is even higher.

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	★★★★	★★★	★★

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	★★★	★	★★★	★★

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

BÖHLER W360
ISOBLOC®

THE MATERIAL FOR THE FORGING PROCESS

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

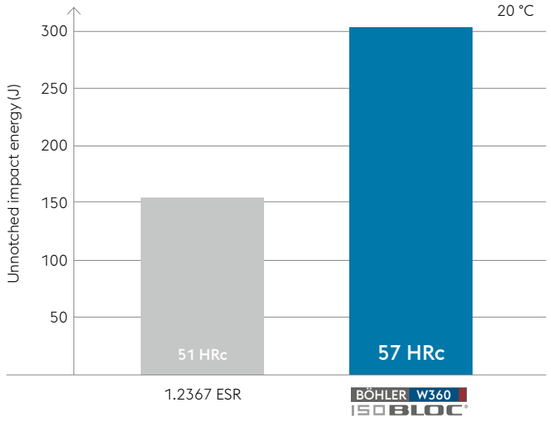
Toughness

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

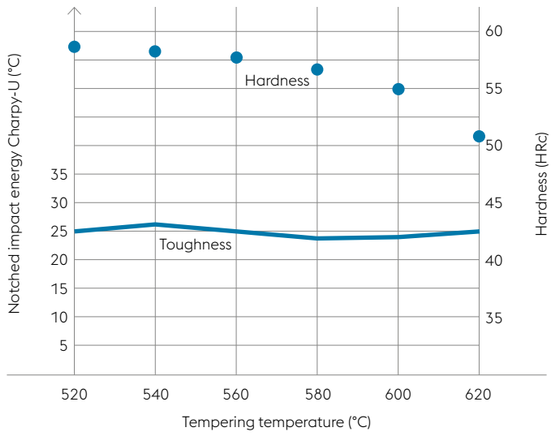
Alongside the outstanding toughness, W360 ISOBLOC is distinguished by its high thermal stability. This is reflected in the high hot hardness and the stability of the material under thermal loading. These properties, combined in W360 ISOBLOC, ensure a high resistance to thermal fatigue and catastrophic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

Toughness (unnotched)



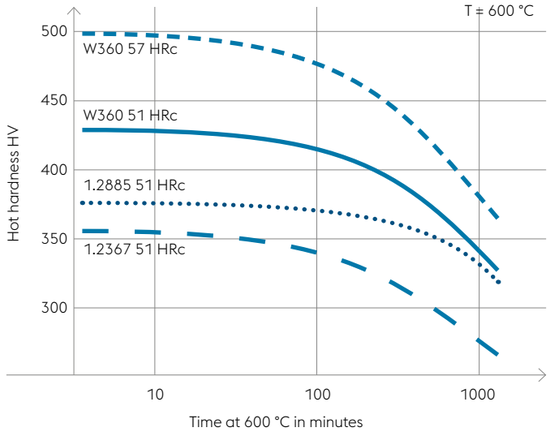
BÖHLER W360 ISOBLOC has a significantly higher toughness than 1.2367 ESR – at a higher hardness.

Toughness at 500 °C



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.

Hot 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.

PLASTIC
MOULD STEEL

PLASTIC MOULD STEELS

THE MATERIALS FOR SUCCESS IN SERIES

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, it's properties and the heat treatment to meet your requirements best.

BÖHLER grade	Wear resistance	Toughness	Polishability **	Machinabilty in as-supplied condition	Through-hardenability	Grindability	Supplied condition
BÖHLER M200	★★	★★	★★	★★★★★	★	★★	V 290 – 330 HB
BÖHLER M238	★★	★★★★	★★★	★★★	★★★★	★★★	V 290 – 330 HB
BÖHLER M238 EXTRA HIGH HARD	★★★★	★★★	★★★★	★★	★★★★	★★★★	V approx. 40 HRc (HIGH HARD)
BÖHLER M268 VMR®	★★★★	★★★★★	★★★★★	★★	★★★★	★★★★★	V approx. 40 HRc (HIGH HARD)
BÖHLER M261 EXTRA	★★★	★★	★★½	★★★★	★★★	★★	LA approx. 40 HR

MATERIAL PROPERTIES

BÖHLER grade	Corrosion resistance *	Wear resistance	Toughness	Polishability **	Machinabilty in as-supplied condition	Supplied condition
Heat treated, corrosion resistant steels						
BÖHLER M303 EXTRA	★★★★	★★★	★★★★	★★★★	★★★	V approx. 1000 N/mm²
BÖHLER M303 EXTRA HIGH HARD	★★★	★★★★	★★★	★★★★★	★★	V approx. 40 HRc
BÖHLER M314 EXTRA	★★	★★	★★	★½	★★★★	V approx. 1000 N/mm²
BÖHLER M315 EXTRA	★★	★★	★★	★	★★★★★	V approx. 1000 N/mm²
BÖHLER N700	★★★★★	★★★★★	★★★★★	★★½	★★	V approx. 1150 N/mm²
Hardenable, corrosion resistant steels						
BÖHLER M310 ISOPLAST®	★★★★	★★	★★	★★½	★★★★	W max. 225 HB
BÖHLER M333 ISOPLAST®	★★★★★	★★	★★★★★	★★★★★	★★★★	W max. 220 HB
BÖHLER M340 ISOPLAST®	★★★	★★★	★★	★★	★★★	W max. 260 HB
BÖHLER M368 MICROCLEAN®	★★★★	★★★	★★★	★★★★	★★★	W max. 260 HB
BÖHLER M390 MICROCLEAN®	★★	★★★★★	★★	★★★	★	W max. 280 HB
BÖHLER 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.
* high tempered, weight loss test with 20 % boiling acetic acid, 24h
** Rating worked out with polishing expert JOKE Technologies

BÖHLER M268 VMR®

FOR BRIGHT RESULTS

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.

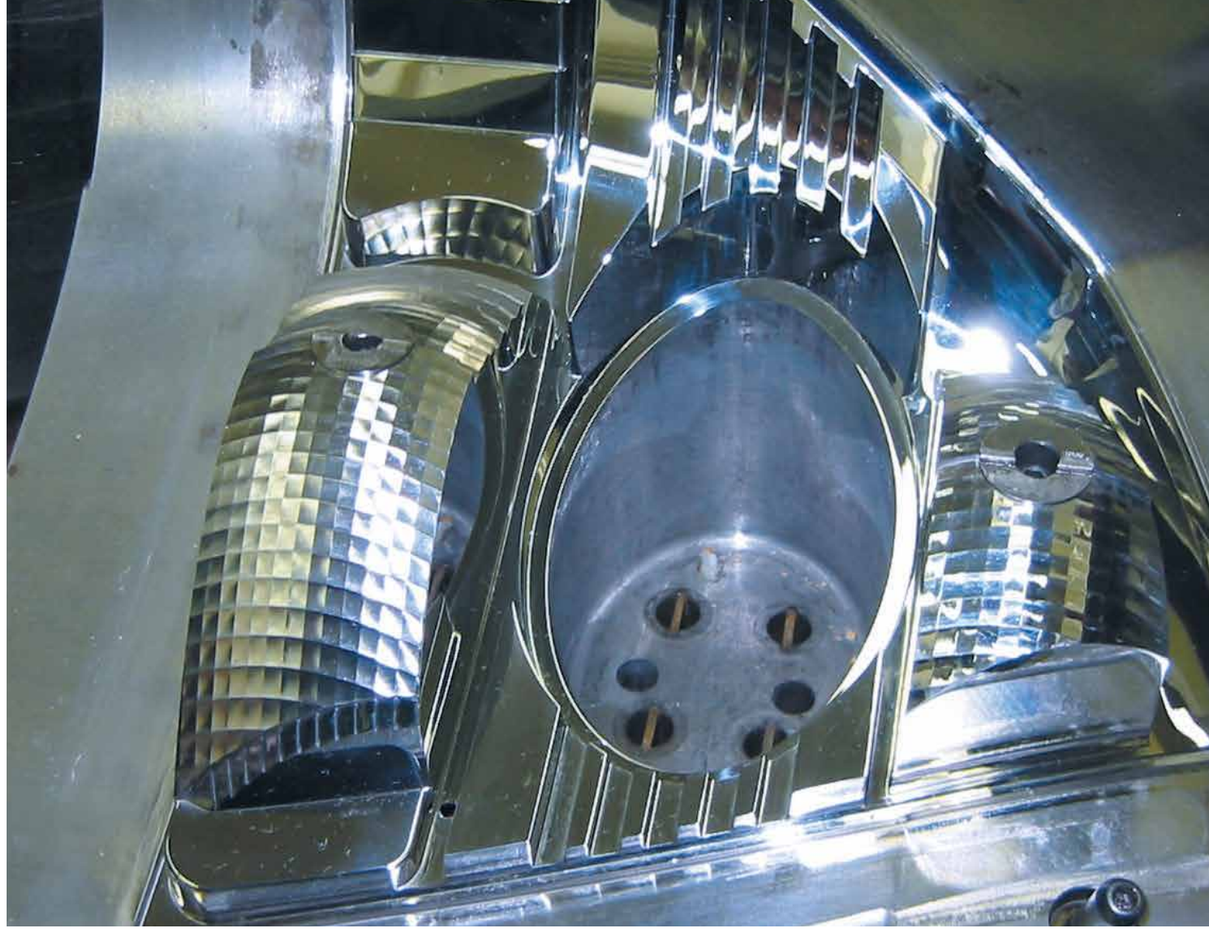
Applications
Moulds for plastics processing, components for general mechanical engineering and tool manufacture where highest polishability and fatigue strength are required.

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

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.



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

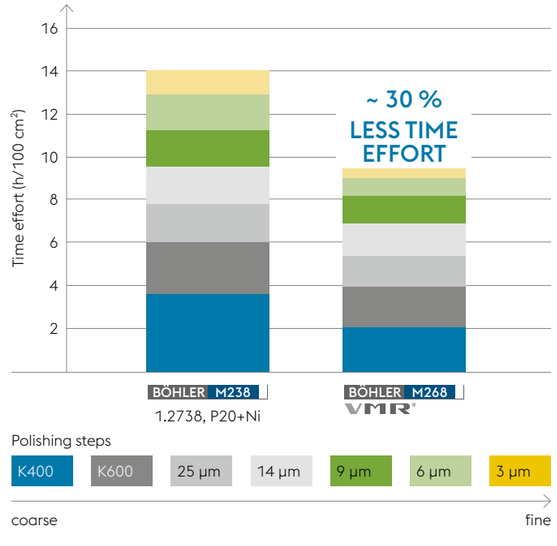
Higher quality
» Uniformly high strength and toughness, even at larger sizes
» High through hardenability
» Excellent thermal conductivity

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

Time effort



BÖHLER M303 EXTRA

THE NEW CLASSIC

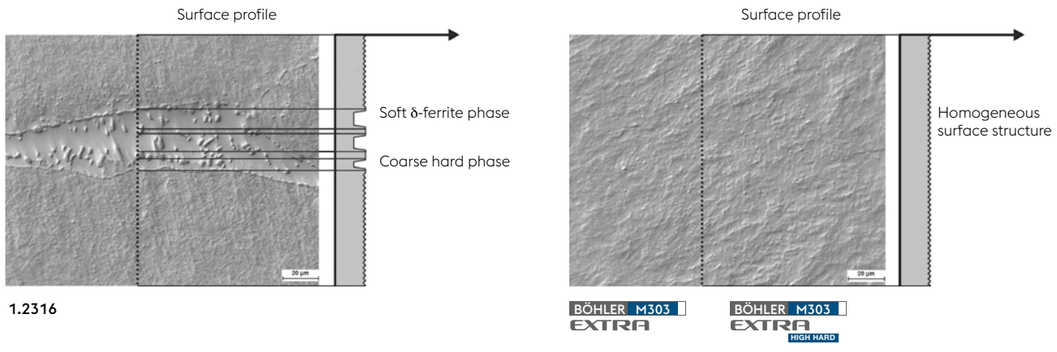
BÖHLER M303 EXTRA is a corrosion resistant martensitic chromium steel, offering **excellent toughness, corrosion** and **wear resistance**. It is characterized by **improved machinability and polishability**.

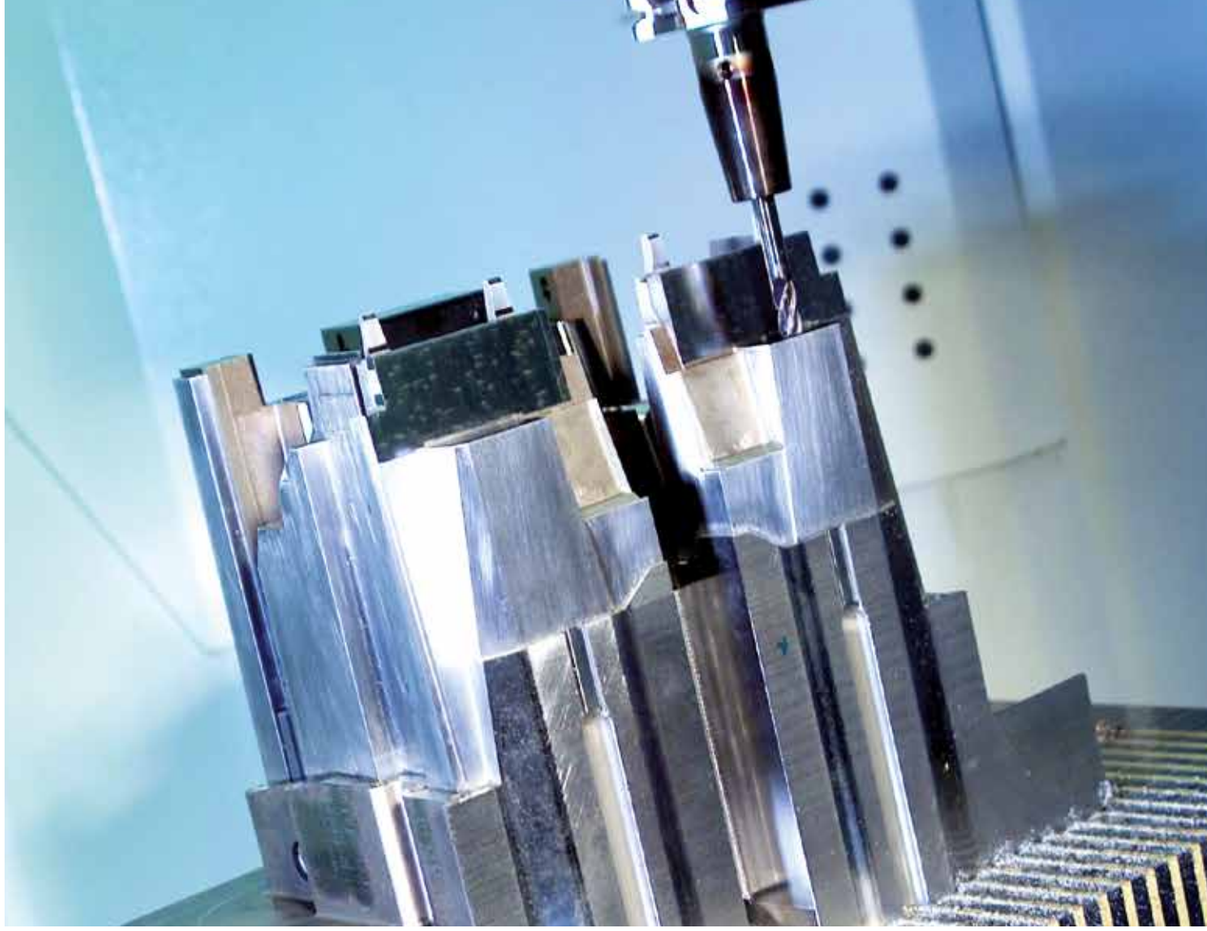
And what is special about it – BÖHLER M303 EXTRA was developed for improved homogeneity ensuring excellent usage properties. And the outcome is – compared to 1.2316 – the prevention of delta ferrite in the matrix.

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

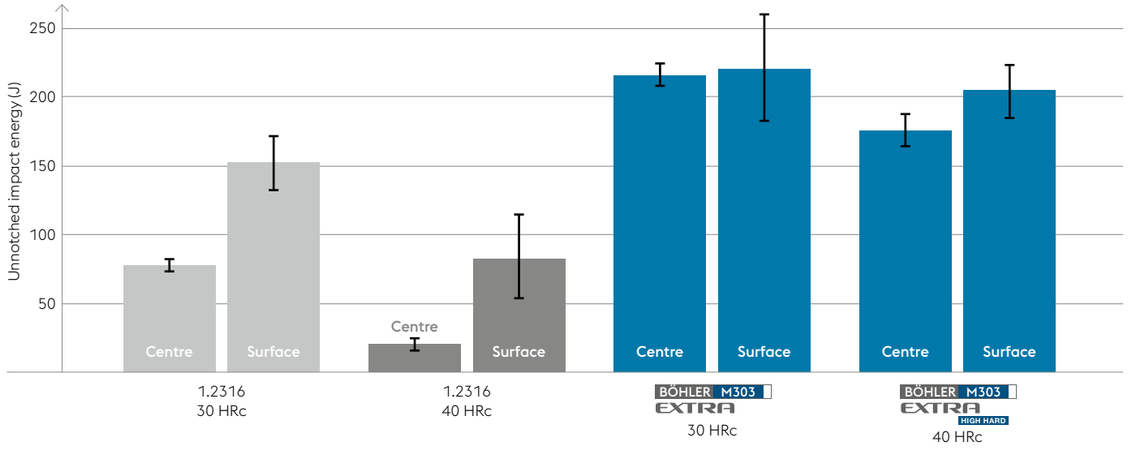
BÖHLER M303 EXTRA	BÖHLER M303 EXTRA HIGH HARD
Hardened and tempered: 290 – 330 HB	Hardened and tempered: 350 – 390 HB

Surface comparison





Toughness (unnotched)



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.

BÖHLER M333
ISOPLAST®

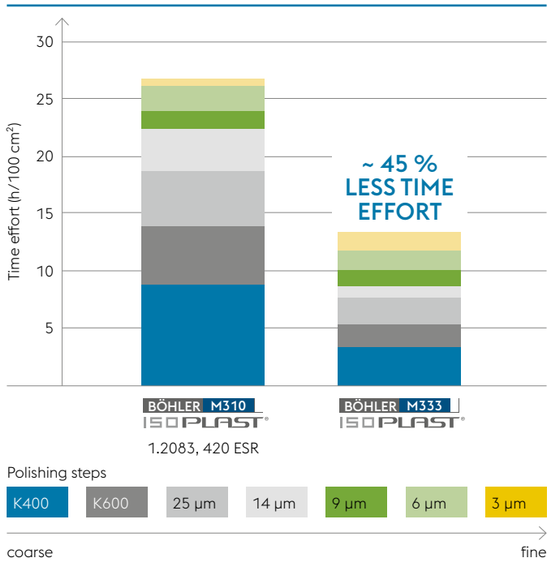
HIGH GLOSS POLISHABLE AND CORROSION RESISTANT

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.

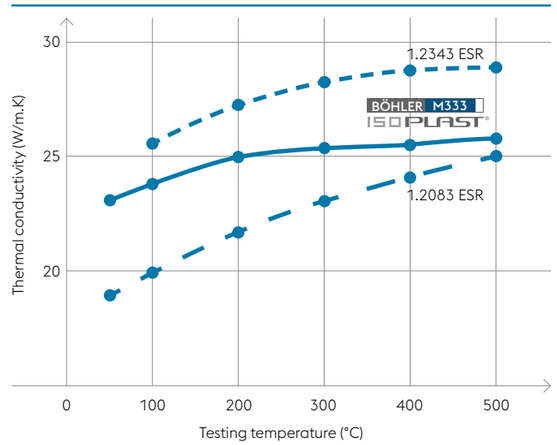
Advantage of BÖHLER M333 ISOPLAST at a glance:

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

Time effort



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®

FOR SPECIAL WEAR APPLICATIONS

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

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

enable ↓

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

Benefit ↓

- **INCREASED PRODUCTIVITY**
- **REDUCED UNIT COSTS**

Fields of application

- 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

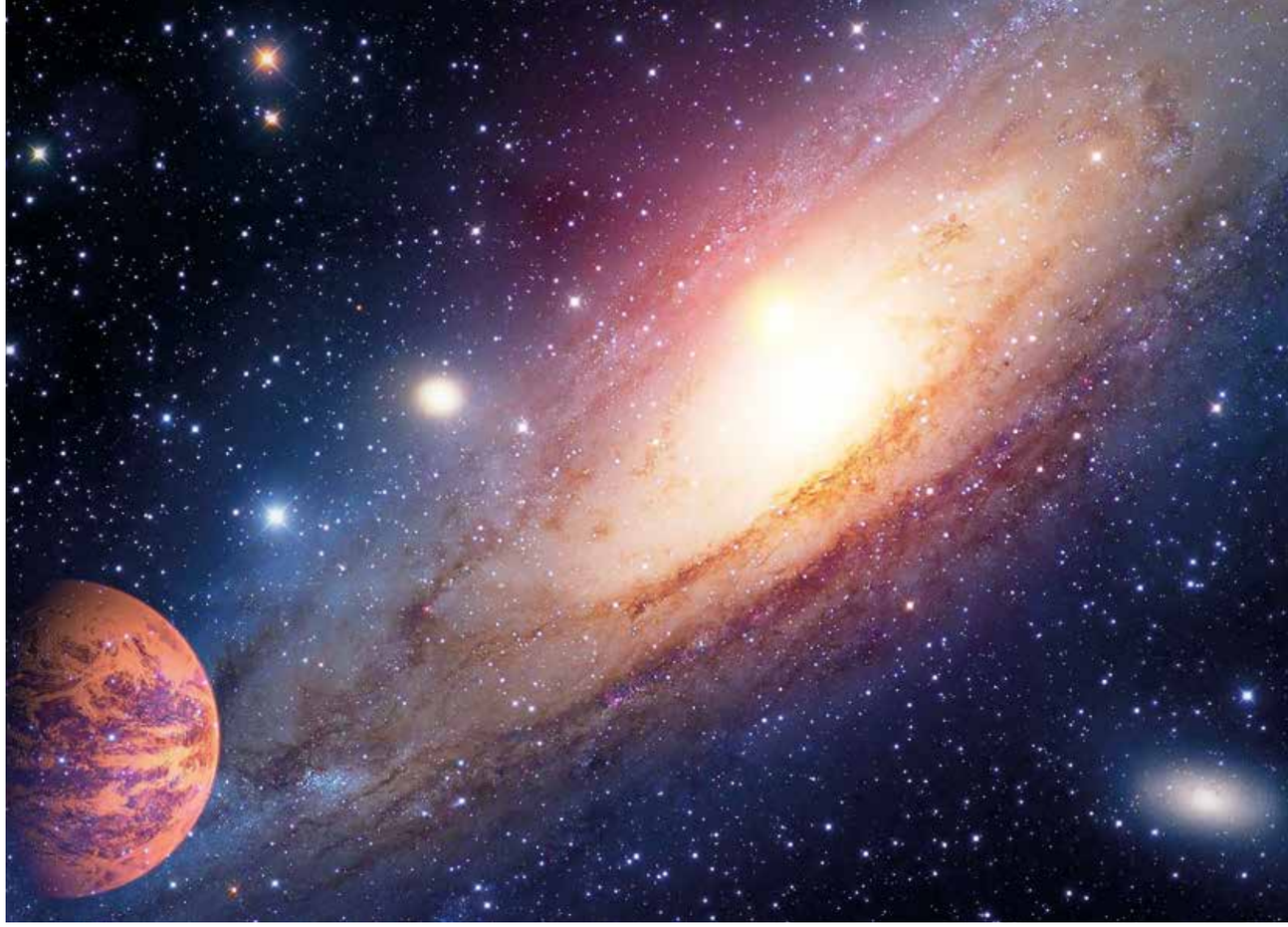
POWDER METALLURGY

POWDER METALLURGICAL HIGH PERFORMANCE TOOL STEELS

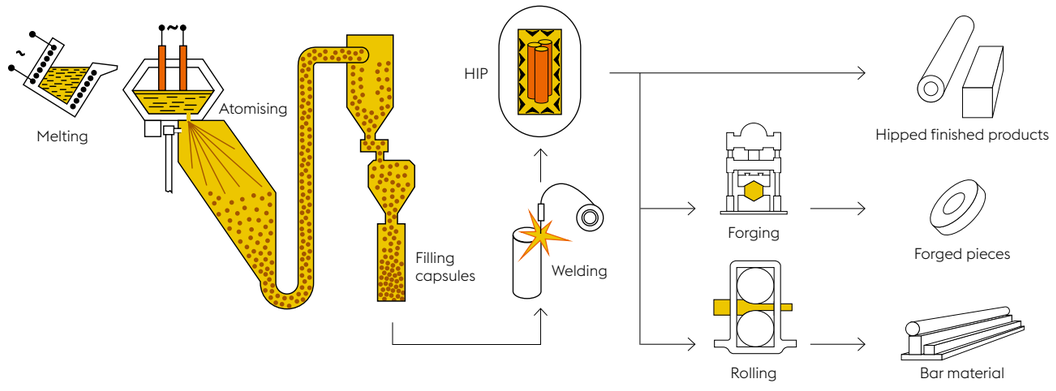
3rd generation high speed steels and tool steels made from uniquely fine, pure powder produced in the world's most modern PM plant at voestalpine BÖHLER Edelstahl in Kapfenberg, Austria.

- 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.



The production process for BÖHLER MICROCLEAN



BÖHLER grade	Chemical composition in %										Standards	
	C	Si	Mn	Cr	Mo	Ni	V	W	Co	Others	DIN/ EN	AISI
BÖHLER S290 MICROCLEAN	2.00	0.50	0.30	3.80	2.50	–	5.10	14.30	11.00	–	Patent	–
BÖHLER S390 MICROCLEAN	1.64	0.45	0.30	4.80	2.00	–	4.80	10.40	8.00	–	–	–
BÖHLER S590 MICROCLEAN	1.29	0.60	0.30	4.20	5.00	–	3.00	6.30	8.40	–	1.3244 HS6-5-3-8	–
BÖHLER S690 MICROCLEAN	1.35	0.60	0.30	4.10	5.00	–	4.10	5.90	–	–	~ 1.3351 ~ HS6-5-4	~ M4
BÖHLER S790 MICROCLEAN	1.29	0.60	0.30	4.20	5.00	–	3.00	6.30	–	–	1.3345 HS6-5-3C	~ M3 Cl.2
BÖHLER K390 MICROCLEAN	2.45	0.55	0.40	4.15	3.75	–	9.00	1.00	2.00	–	Patent	–
BÖHLER K490 MICROCLEAN	1.40	–	–	6.40	1.50	–	3.70	3.50	–	Nb	–	–
BÖHLER K890 MICROCLEAN	0.85	0.55	0.40	4.35	2.80	–	2.10	2.55	4.50	–	Patent	–
BÖHLER M368 MICROCLEAN	0.54	0.45	0.40	17.30	1.10	–	0.10	–	–	+N		
BÖHLER M390 MICROCLEAN	1.90	0.60	0.30	20.00	1.00	–	4.00	0.60	–	–	Patent	–

BÖHLER 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

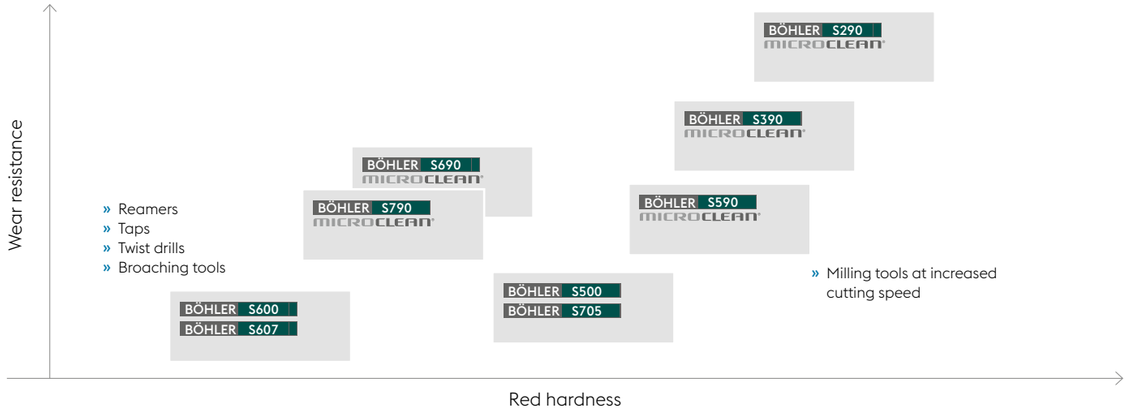
ensuring ↓

- **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.

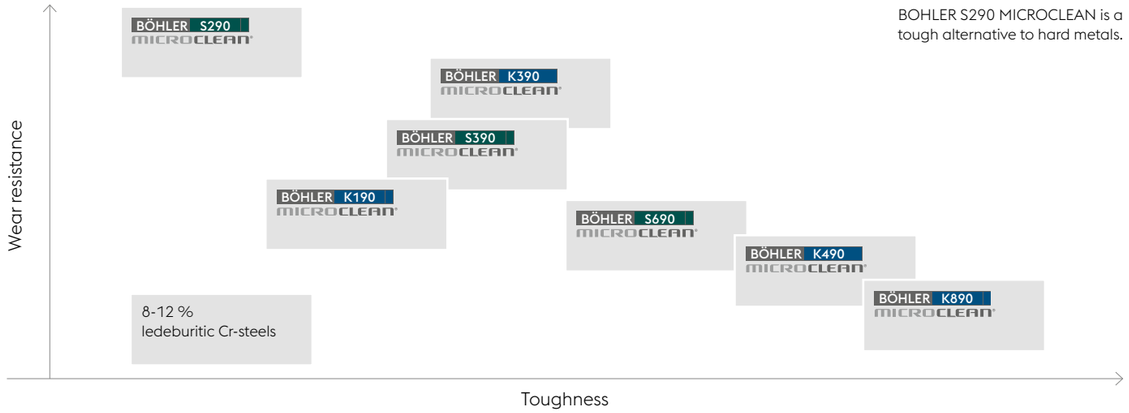
Property profile of BÖHLER high speed steel for cutting applications



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.

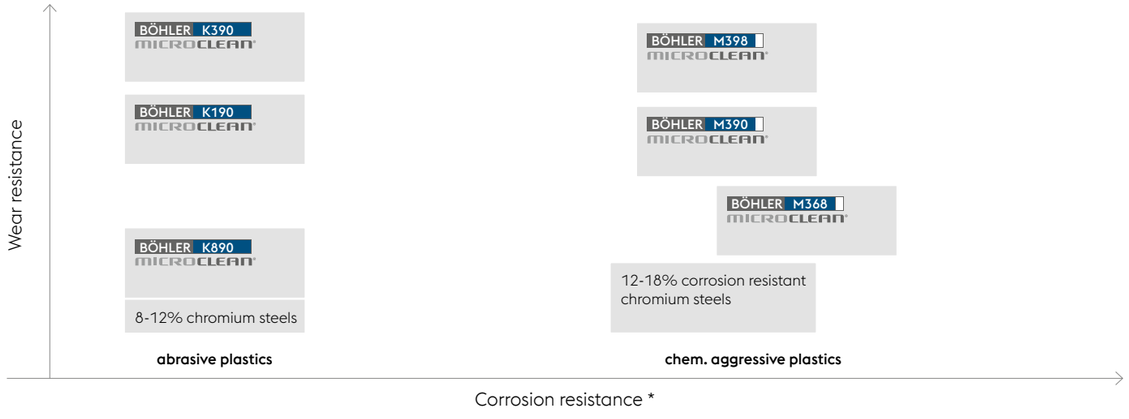
Property profile of BÖHLER cold work tool steels and high speed steels for cold work applications



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**.

Property profile of BÖHLER tool steels for the plastics processing industry



* High tempered, weight loss test with 20% boiling acetic acid, 24 h.

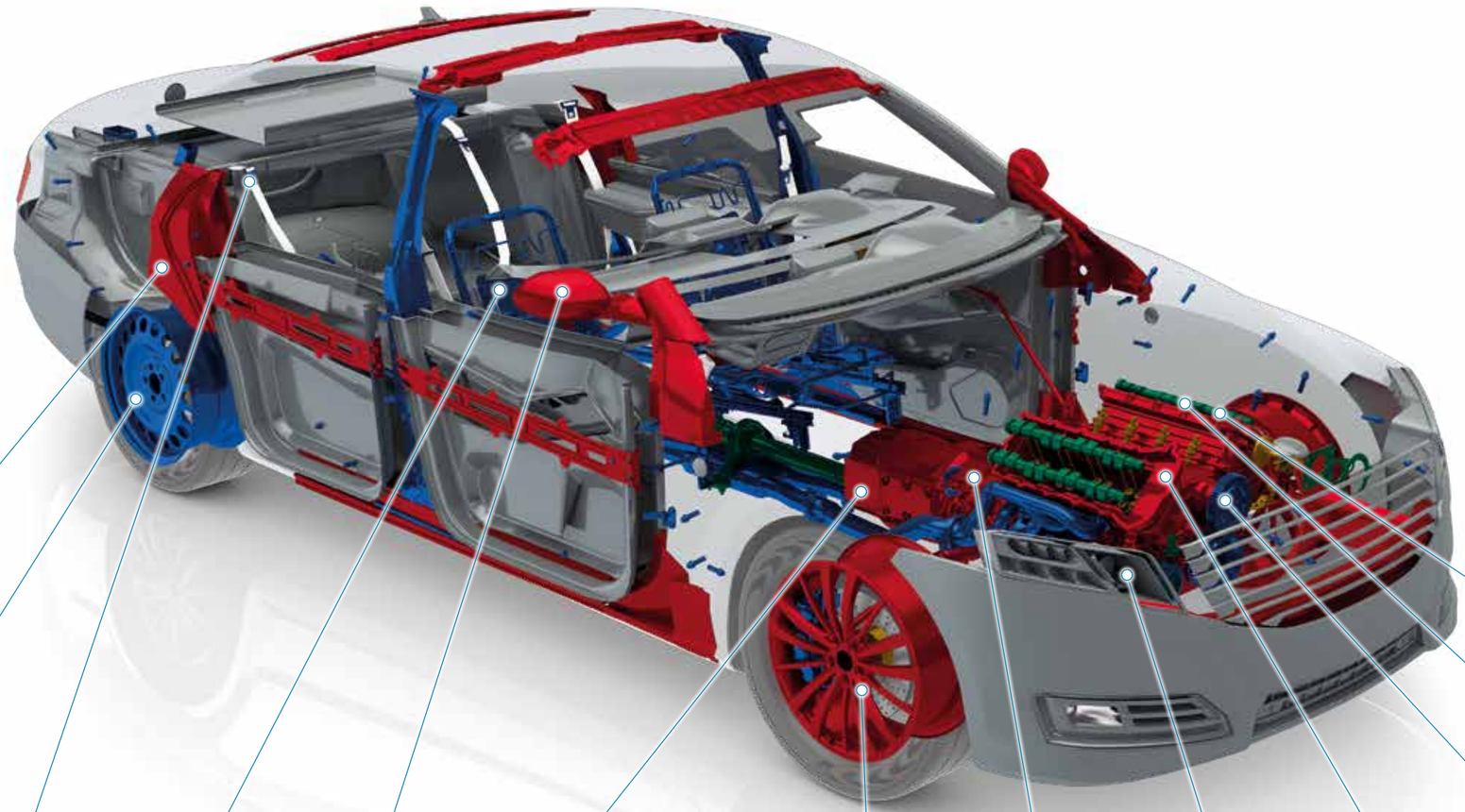
HIGH PERFORMANCE TOOLING FOR THE AUTOMOTIVE INDUSTRY

COLD WORK TOOL STEEL

HOT WORK TOOL STEEL

PLASTIC MOULD STEEL

HIGH SPEED STEEL



LONGITUDINAL BEAMS – A-B-C-PILLAR, GEARBOX 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®

WHEEL RIMS

- BÖHLER W300 ISOBLOC®
- 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 HOUSINGS

- 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®

PISTON ROD

- BÖHLER W360 ISOBLOC®

HIGH SPEED STEEL

HIGH SPEED STEELS

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.)

BÖHLER grade	Red hardness	Wear resistance	Toughness	Grindability	Compressive strength
MICROCLEAN					
BÖHLER S290 MICROCLEAN					
BÖHLER S390 MICROCLEAN					
BÖHLER S393 MICROCLEAN					
BÖHLER S590 MICROCLEAN					
BÖHLER S690 MICROCLEAN					
BÖHLER S790 MICROCLEAN					

BÖHLER grade	Red hardness	Wear resistance	Toughness	Grindability	Compressive strength
CONVENTIONAL HIGH SPEED STEEL					
BÖHLER S200					
BÖHLER S400					
BÖHLER S401					
BÖHLER S404					
BÖHLER S600					
BÖHLER S607					
BÖHLER S630					
BÖHLER S500					
BÖHLER S705					
BÖHLER S730					

BÖHLER grade	Chemical composition in %							Standards		
	C	Cr	W	Mo	V	Co	Others	DIN / EN		AISI
MICROCLEAN										
BÖHLER S290 MICROCLEAN	2.00	3.80	14.30	2.50	5.10	11.00	–	–		–
BÖHLER S390 MICROCLEAN [1) 2)]	1.64	4.80	10.40	2.00	4.80	8.00	–	–		–
BÖHLER S393 MICROCLEAN	1.64	4.00	12.10	–	4.80	5.00	–	–		T15
BÖHLER S590 MICROCLEAN [1) 2)]	1.29	4.20	6.30	5.00	3.00	8.40	–	< 1.3244 >	HS6-5-3-8	–
BÖHLER S690 MICROCLEAN [2)]	1.35	4.10	5.90	5.00	4.10	–	–	~ 1.3351	~ HS6-5-4	~ M4
BÖHLER S790 MICROCLEAN [1) 2)]	1.29	4.20	6.30	5.00	3.00	–	–	< 1.3345 >	HS6-5-3C	~ M3 Cl.2
ISORAPID										
BÖHLER S600 ISORAPID	0.90	4.10	6.20	5.00	1.80	–	–	< 1.3343 > ~ 1.3554 LW	HS6-5-2C	~ M2 reg.C
CONVENTIONAL HIGH SPEED STEEL										
BÖHLER S200	0.76	4.10	18.00	–	1.10	–	–	< 1.3355 >	HS18-0-1	T1
BÖHLER S400	1.02	3.80	1.80	8.60	1.90	–	–	< 1.3348 >	HS2-9-2	M7
BÖHLER S401	0.84	3.80	1.80	8.60	1.20	–	–	< 1.3346 >	HS2-9-1	M1
BÖHLER S404	0.89	3.80	1.00	4.30	1.80	–	–	< 1.3326 >	HS2-4-1	M52
BÖHLER S600 [1)]	0.90	4.10	6.20	5.00	1.80	–	–	< 1.3343 > ~ 1.3554 LW	HS6-5-2C	~ M2 reg.C
BÖHLER S607	1.21	4.10	6.20	5.00	2.90	–	–	< 1.3344 >	HS6-5-3	~ M3 Cl. 2
BÖHLER S630 [3)]	0.95	4.00	4.00	4.00	2.00	–	+ Al	< 1.3330 >	HS4-4-2	–
BÖHLER S500 [1)]	1.10	3.90	1.40	9.20	1.00	7.80	–	< 1.3247 >	HS2-9-1-8	~ M42
BÖHLER S705 [1)]	0.92	4.10	6.20	5.00	1.90	4.80	–	< 1.3243 >	HS6-5-2-5	~ M35
BÖHLER S730 [3)]	0.92	4.10	4.25	4.15	1.95	4.75	+ Al	< 1.3230 >	HS4-4-2-5	–

[1)] also available in the BHT execution

[2)] also available with sulphur as S392 MICROCLEAN, S592 MICROCLEAN, S692 MICROCLEAN, S792 MICROCLEAN;

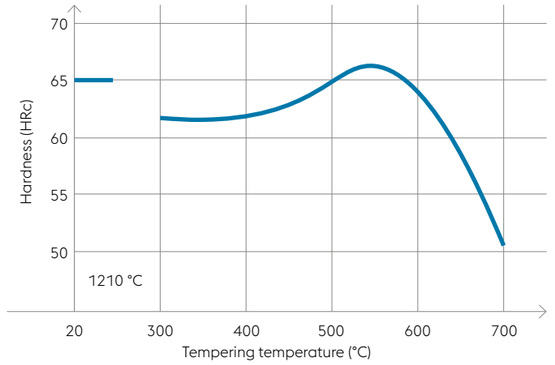
[3)] BÖHLER Patent

HIGH SPEED STEEL

HIGH SPEED STEELS

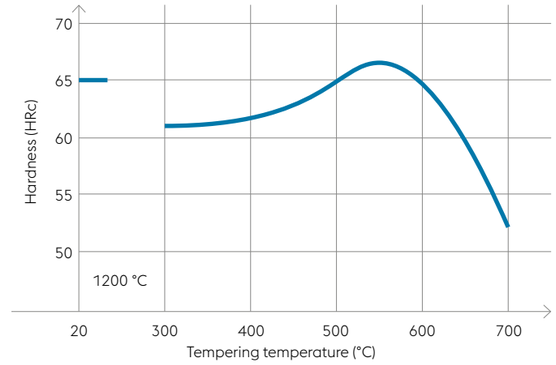
BÖHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness after tempering
BÖHLER S500	max. 280 HBW	1160 – 1180 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	67 – 69 HRc
BÖHLER S600	max. 280 HBW	1190 – 1230 °C	Oil, Air, Salt bath (500 – 550 °C), Gas	64 – 66 HRc
BÖHLER S705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

Tempering chart BÖHLER S600



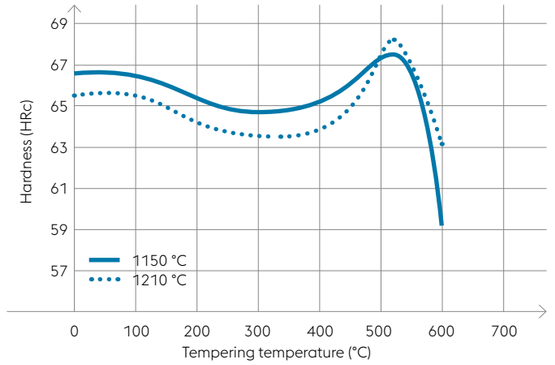
Sample size: square 20 mm

Tempering chart BÖHLER S705



Sample size: square 20 mm

Tempering chart BÖHLER S390 MICROCLEAN



Sample size: square 25 mm, holding time: 3 x 2 h

COLD WORK TOOL STEELS

COLD WORK TOOL STEEL

BÖHLER grade	Chemical composition (nominal in wt.%)						Standards	
	C	Cr	Mo	V	W	Others	DIN / EN	AISI
BÖHLER K100	2.00	11.50	–	–	–	–	1.2080 X210Cr12	~ D3
BÖHLER K110	1.55	11.50	0.75	0.75	–	–	1.2379 X155CrVMo12-1	D2
BÖHLER K305	1.00	5.20	1.10	0.25	–	–	1.2363 X100CrMoV5-1	A2
BÖHLER K353	0.82	8.00	1.60	0.60	–	+ Al	Patented	–
BÖHLER K455	0.63	1.10	–	0.18	2.00	–	1.2550 60WCrV7	~ S1
BÖHLER K600	0.45	1.30	0.25	–	–	Ni = 4.00	1.2767 45NiCrMo16	–
BÖHLER K340 ISODUR®	1.10	8.30	2.10	0.50	–	+ Al + Nb	Patented	–
BÖHLER K360 ISODUR®	1.25	8.75	2.70	1.18	–	+ Al + Nb	Patented	–
MICROCLEAN								
BÖHLER K390 MICROCLEAN®	2.45	4.15	3.75	9.00	1.00	Co = 2.00	Patented	–
BÖHLER K490 MICROCLEAN®	1.40	6.40	1.50	3.70	3.50	+ Nb	Patented	–
BÖHLER K890 MICROCLEAN®	0.85	4.35	2.80	2.10	2.55	Co = 4.50	Patented	–

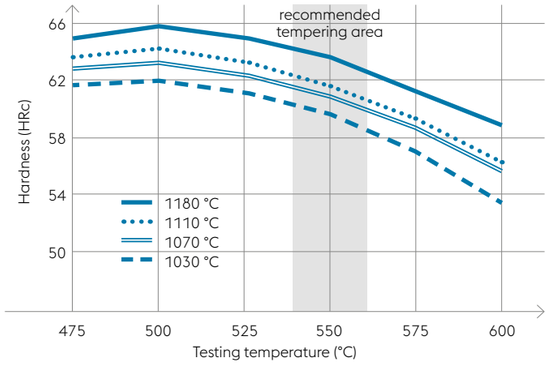
BÖHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness	Average Rockwell C hardness after tempering at °C						
					100	200	300	400	500	520	550
BÖHLER K100	max. 248 HB	940 – 970 °C	Oil, Air (< 25 mm Ø), Gas, Salt bath (220 – 250 °C / 500 – 550 °C)	57 – 62 HRc	64	62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

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)

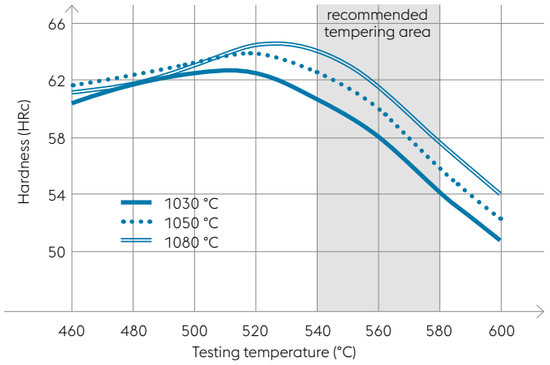
» Very stable mechanical properties, regardless of the hardening temperature (1030 – 1080 °C)

Tempering chart BÖHLER K390 MICROCLEAN



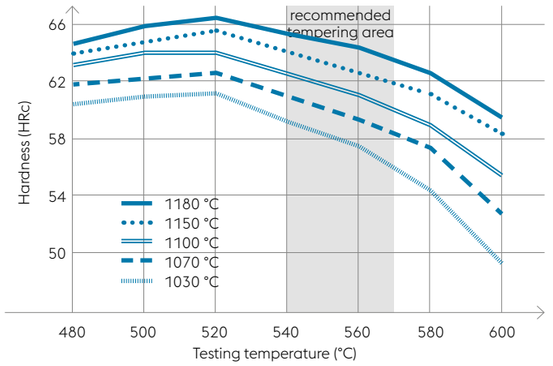
hardened in vacuum furnace: N_2 cooling, 5 bar

Tempering chart BÖHLER K490 MICROCLEAN



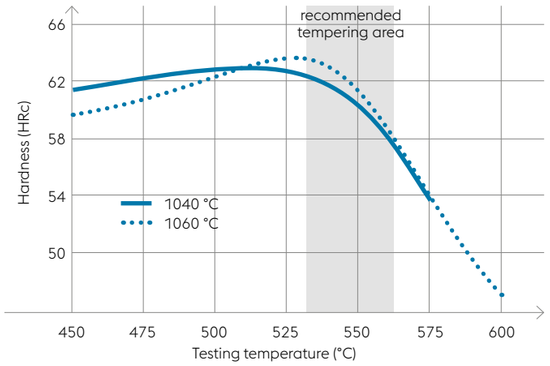
Sample size: round 35 x 15 mm

Tempering chart BÖHLER K890 MICROCLEAN

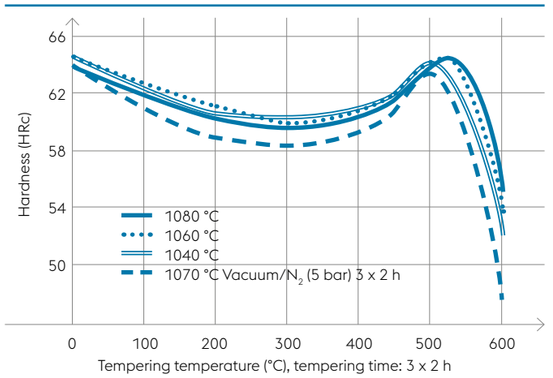


hardened in vacuum furnace: N_2 cooling, 5 bar

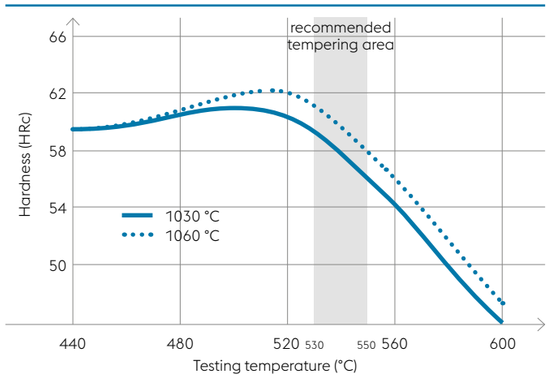
Tempering chart BÖHLER K340 ISODUR



Tempering chart BÖHLER K360 ISODUR



Tempering chart BÖHLER K353



HOT WORK TOOL STEEL

HOT WORK TOOL STEELS

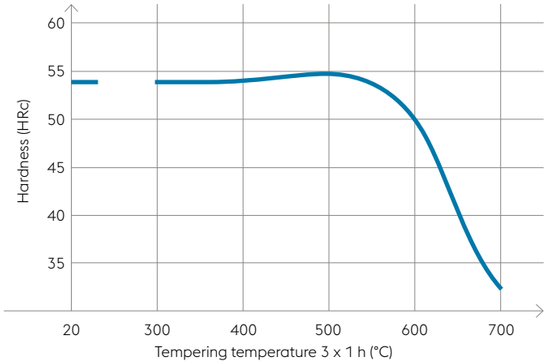
BÖHLER grade	Type of alloy %					Standard		
	C	Cr	Mo	V	Others	DIN / EN		AISI
BÖHLER W300 [1]	0.38	5.00	1.30	0.40	Si = 1.10	< 1.2343 >	X38CrMoV51	H11
BÖHLER W302 [1]	0.39	5.20	1.40	0.95	Si = 1.10	< 1.2344 >	X40CrMoV51	H13
BÖHLER W303	0.38	5.00	2.80	0.55	–	< 1.2367 >	X38CrMoV53	–
BÖHLER W320	0.31	2.90	2.70	0.50	–	< 1.2365 >	32CrMoV1228 (X32CrMoV33)	H10
BÖHLER W350 ISOBLOC®	0.38	5.00	1.75	0.55	Si 0.20 N def.	–	–	–
BÖHLER W360 ISOBLOC®	0.50	4.50	3.00	0.60	Si = 0.20	–	–	–
BÖHLER W400 VMR®	0.36	5.00	1.30	0.45	Si = 0.20	< 1.2340 >	–	~ H11
BÖHLER W403 VMR®	0.38	5.00	2.80	0.65	–	–	–	–
BÖHLER W720 VMR®	max. 0.005	–	5.00	–	Ni = 18.50 Co = 9.00 Ti = 0.70 Al = 0.10	~1.2709 1.6358	– X3NiCoMo1885 – X2NiCoMo1895	–

Further details regarding these steels can be found in the data sheet for each steel.
[1] Conventional quality available as ISODISC, ESR quality available as ISOBLOC.

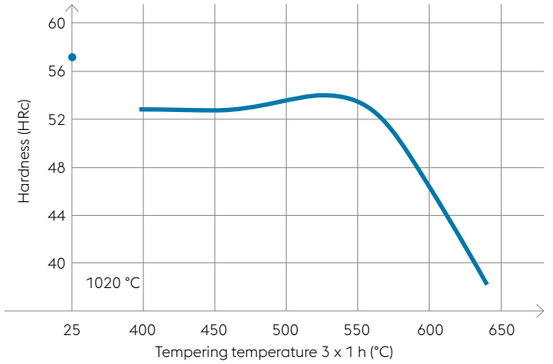
BÖHLER grade	Hardness after annealing	Hardening temperature	Quenchant	Obtainable hardness	Average Rockwell C hardness after tempering at °C					
					400	500	550	600	650	700
BÖHLER W300 ISOBLOC®	max. 205 HB	1000 – 1040 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	53	54	52	48	38	30
			Air, Gas	50 – 54 HRc						
BÖHLER W302 ISOBLOC®	max. 205 HB	1020 – 1080 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	54	55	54	50	40	32
			Air, Gas	50 – 54 HRc						
BÖHLER W303 ISODISC®	max. 205 HB	1030 – 1080 °C	Oil, Salt bath (500 – 550 °C)	52 – 56 HRc	52	54	53	50	44	36
			Air, Gas	50 – 54 HRc						
BÖHLER W320 ISOBLOC®	max. 205 HB	1010 – 1050 °C	Oil, Salt bath, (500 – 550 °C), Gas	52 – 56 HRc	50	51	52	50	45	36
BÖHLER W350 ISOBLOC® [1]	max. 240 HB	1020 °C (1010 °C*)	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	–	–	–	–	–	–
			Air, Gas	50 – 53 HRc						
BÖHLER W360 ISOBLOC®	max. 205 HB	approx. 1050 °C	Oil, Salt bath (500 – 550 °C) Air, Gas	57 – 58 HRc	see tempering chart					
BÖHLER W400 VMR®	max. 205 HB	980 – 990 °C	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	53	54	52	48	38	30
			Air, Gas	50 – 53 HRc						
BÖHLER W403 VMR®	max. 205 HB	1020 – 1030 °C	Oil, Salt bath (500 – 550 °C)	52 – 54 HRc	52	54	53	50	44	35
			Air, Gas	50 – 53 HRc						

[1] for big dies

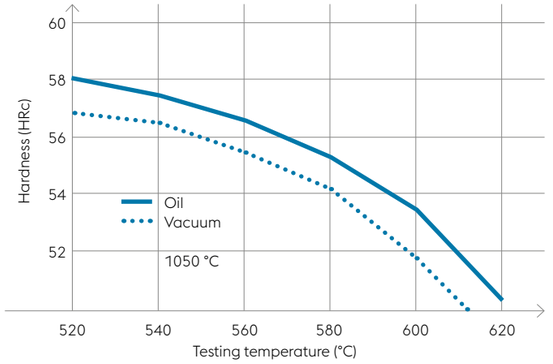
Tempering chart BÖHLER W302 ISOBLOC



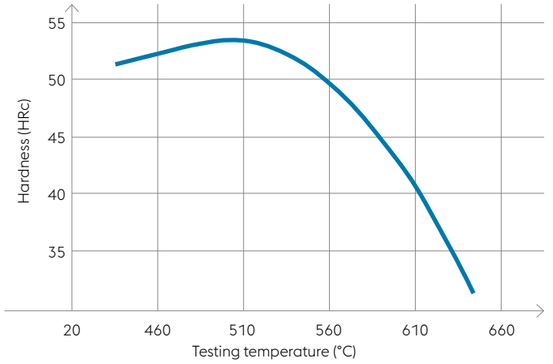
Tempering chart BÖHLER W350 ISOBLOC



Tempering chart BÖHLER W360 ISOBLOC



Tempering chart BÖHLER W403 VMR



PLASTIC MOULD STEEL

PLASTIC MOULD STEELS

BÖHLER grade	Chemical composition in %						Standards		
	C	Cr	Mo	Ni	V	Others	DIN / EN		AISI
CORROSION RESISTANT STEELS									
BÖHLER M303 EXTRA [1)]	0.27	14.50	1.00	0.85	–	+ N	~ 1.2316	X36CrMo17	–
BÖHLER M303 EXTRA HIGH HARD	0.27	14.50	1.00	0.85	–	+ N	~ 1.2316	X36CrMo17	–
BÖHLER M310 ISOPLAST®	0.38	14.30	–	–	0.20	–	~ 1.2083	X42Cr13 X40Cr14	~ 420
BÖHLER M314	0.32	16.00	0.15	+	–	Mn = 1.10 S = 0.10	< 1.2085 >	X33CrS16	–
BÖHLER M315 EXTRA	0.05	12.50	–	+	–	Mn = 0.90 Si = 0.40 S = 0.12	–	–	–
BÖHLER M333 ISOPLAST®	0.24	13.25	+	+	+	+ N	–	–	~ 420
BÖHLER M340 ISOPLAST®	0.54	17.30	1.10	–	0.10	+ N	–	–	–
POWDER METALLURGY STEELS									
BÖHLER M368 MICROCLEAN®	0.54	17.30	1.10	–	0.10	+ N	–	–	–
BÖHLER M390 MICROCLEAN®	1.90	20.00	1.00	–	4.00	W = 0.60	–	–	–
PRE-HEAT TREATED AND PRECIPITATION HARDENING STEELS									
BÖHLER M200	0.40	1.90	0.20	–	–	Mn = 1.50 S = 0.08	< 1.2312 >	40CrMnMoS8-6	~ P20
BÖHLER M238	0.38	2.00	0.20	1.10	–	Mn = 1.50	< 1.2738 >	40CrMnNiMo8-6-4	–
BÖHLER M238 HIGH HARD	0.38	2.00	0.20	1.10	–	Mn = 1,50	< 1.2738 >	40CrMnNiMo8-6-4	–
BÖHLER M261 EXTRA	0.13	0.35	–	3.50	–	Mn = 2.00 S = 0.15 Cu = 1.20 Al = 1.20	–	–	–
BÖHLER M268 VMR®	0.38	2.00	0.20	1.10	–	Mn = 1.50	< 1.2738 >	40CrMnNiMo8-6-4	–
CASE-HARDENING STEELS									
BÖHLER M100	0.20	1.10	–	–	–	Mn = 1.20	< 1.2162 >	21MnCr5	–
BÖHLER M130	0.19	1.30	0.20	4.10	–	–	< 1.2764 >	X19NiCrMo4	–

[1)] also available as ESR-grade

BÖHLER grade	Hardness after annealing	Hardening temp. Quenchant	Supplied condition N/mm²	Average surface hardness after hardening Rockwell C	Normal assembly condition
BÖHLER M238	–	840 – 860 °C Oil	approx. 1000	–	hardened and tempered
BÖHLER M261 EXTRA	approx. 30 HRc solution annealed	560 – 580 °C Air	–	approx. 40	solution annealed and precipitation hardened
BÖHLER M268 VMR®	–	840 – 880 °C Oil	approx. 1200	–	hardened and tempered
BÖHLER M303 ISOPLAST®	–	1000 – 1020 °C / Oil, Gas, Salt bath (400 – 450 °C)	900 - 1120	– 48 – 53 Oil	hardened and tempered
BÖHLER M310 ISOPLAST® [2)]	max. 200 HBW	1000 – 1050 °C Gas, Salt bath, Oil	–	–	hardened and tempered
BÖHLER M315 EXTRA [2)]	–		approx. 1000	–	hardened and tempered
BÖHLER M333 ISOPLAST® [2)]	max. 220 HBW	980 – 1000 °C Oil, Gas	–	48 – 52	hardened and tempered
BÖHLER M340 ISOPLAST® [2)]	max. 260 HBW	980 – 1000 °C Oil, Gas	–	53 – 56	hardened and tempered
BÖHLER M368 MICROCLEAN® [2)]	max. 280 HBW	980 – 1000 °C Oil, Gas	–	48 – 55	hardened and tempered
BÖHLER M390 MICROCLEAN® [2)]	max. 280 HBW	1120 – 1180 °C Oil, Gas, Salt bath	–	58 – 60	hardened and tempered

[2)] for certain applications sub zero treatment is recommended for dimensional stability

SPECIAL MATERIALS AEROSPACE

SPECIAL 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. voestalpine 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)
- » voestalpine BÖHLER Aerospace
- » 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

SPECIAL MATERIALS POWER GENERATION

SPECIAL MATERIALS

MATERIALS FOR THE POWER GENERATION

Innovation is the power for high performance

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.

As an energy generating 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.

The best test results

The voestalpine 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!

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

SPECIAL MATERIALS

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 voestalpine 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 voestalpine BÖHLER. As one of the few producers of steel we at voestalpine 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
» bmwfw, 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

AMPO

BÖHLER AMPO

BÖHLER L625 AMPO

BÖHLER N700 AMPO

BÖHLER W360 AMPO

BÖHLER L718 AMPO

BÖHLER W722 AMPO

BÖHLER M789 AMPO

SCIENCE! NO FICTION

Additive Manufacturing Powder

voestalpine BÖHLER Edelstahl has expanded the portfolio and offers four **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.

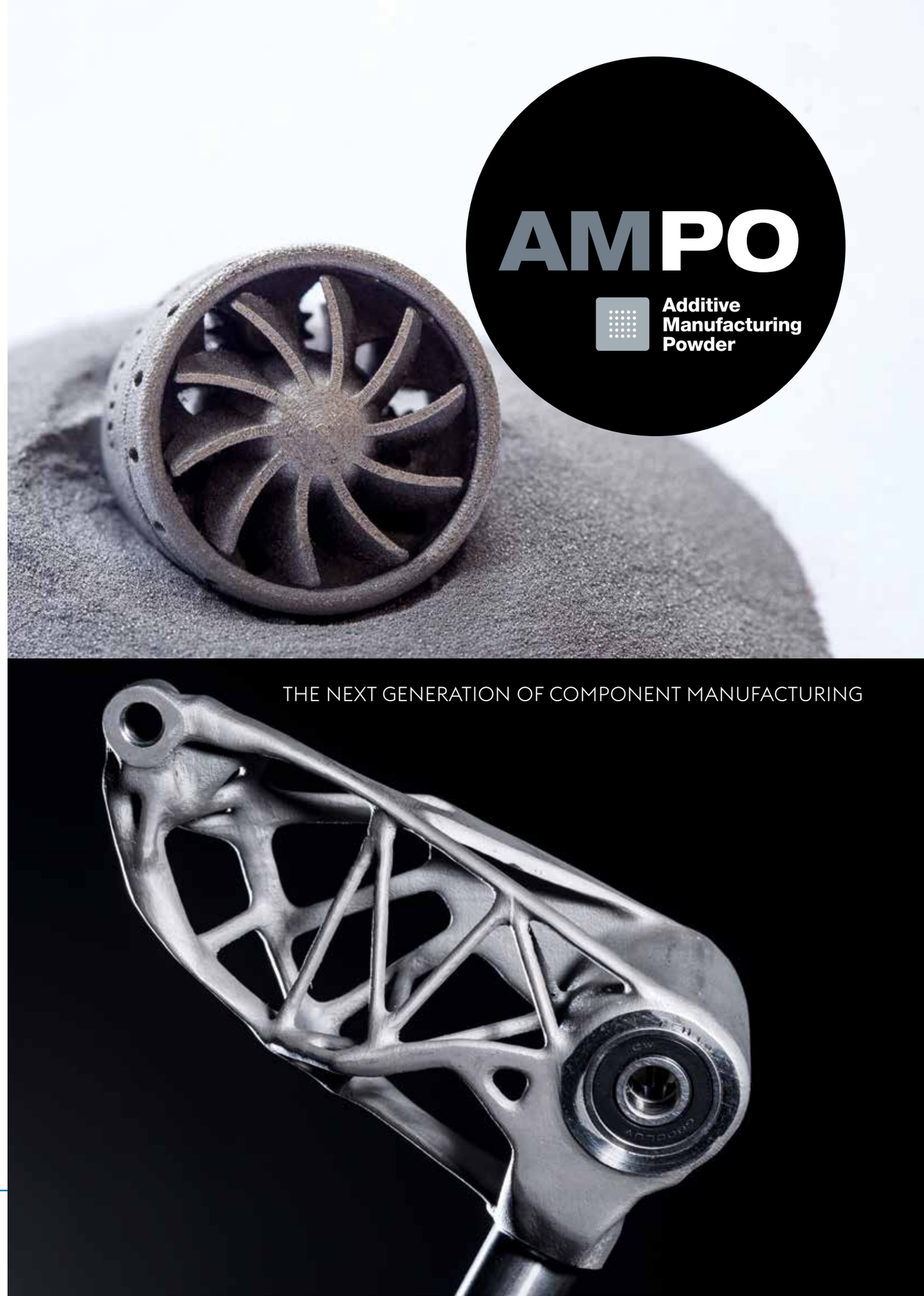
» **STATE OF THE ART TECHNOLOGY**
Vacuum induction melting and atomization under inert gas **ensure the highest product quality. Powder is produced on latest atomization techniques** and tested in-house.

» **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**
voestalpine 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.

» **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 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.

Particle size distribution* (µm)

	15 – 45 (e.g. laser powder bed fusion)		**45 – 150** (e.g. direct laser deposition)	
AMPO grade	**Flowability* (s)**	**Apparent density* (g/cm³)**	**Flowability* (s)**	**Apparent density* (g/cm³)**
BÖHLER L625 AMPO	<22.00	3.80	<19.00	3.80
BÖHLER L718 AMPO	<18.00	3.96	<21.50	3.50
BÖHLER M789 AMPO	4.80 **	3.69	<18.00	3.92
BÖHLER N700 AMPO	<19.00	3.96	<21.50	3.40
BÖHLER W360 AMPO	17.00	4.01	19.00	3.61
BÖHLER W722 AMPO	<18.00	3.90	<22.00	3.30

* 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.
** Measured with Carney flowmeter ASTM B964

BÖHLER L625 AMPO — DIN 2.4856

Chemical Composition (wt. %)

Element	C	Ni	Cr	Mn	P	S	Si	Mo	Fe	Co	Al	Nb+Ta	Ti
min	-	-	21.00	-	-	-	-	8.00	-	-	-	3.20	-
max	0.03	remainder	23.00	0.50	0.01	0.01	0.35	10.00	5.00	1.00	0.40	3.80	0.40

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

Chemical Composition (wt. %)

Element	C	Ni	Cr	Mn	P	S	Si	Mo	Fe	Cu	Co	Al	Nb	Ti
min	0.02	50.00	17.00	-	-	-	-	2.80	remainder	-	-	0.30	4.70	0.65
max	0.08	55.00	21.00	0.35	0.015	0.015	0.35	3.30	remainder	0.30	1.00	0.70	5.50	1.15

BÖHLER M789 AMPO — patent pending

Chemical Composition (wt. %)

Element	C	Ni	Cr	Mo	Al	Ti	Co
Mass - %	< 0.02	10.00	12.20	1.00	0.60	1.00	free

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

Chemical Composition (wt. %)

Element	C	Ni	Cr	Mn	P	S	Si	Mo	Cu	Nb
min	-	3.00	15.00	-	-	-	-	-	3.00	5xC
max	0.07	5.00	17.00	1.50	0.04	0.015	0.70	0.60	5.00	0.45

BÖHLER W360 AMPO — patent

Chemical Composition (wt. %)

Element	C	Cr	Mn	Si	Mo	V	Co
Mass - %	0.50	4.50	0.25	0.20	3.00	0.55	free

BÖHLER W722 AMPO — DIN 1.2709 / ~ MS1 / Marage 300

Chemical Composition (wt. %)

Element	C	Si	Mn	P	S	Cr	Mo	Ni	Ti	Co
min	-	-	-	-	-	-	4.50	17.00	0.80	8.50
max	0.03	0.10	0.15	0.01	0.01	0.25	5.20	19.00	1.20	10.00

Order quantity 10 kg minimum
Particle size distribution 15 to 45 µm, 45 to 150 µm, or customized after request

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

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. Measurement data are laboratory values and can deviate from practical analyses. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.

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voestalpine
ONE STEP AHEAD.

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