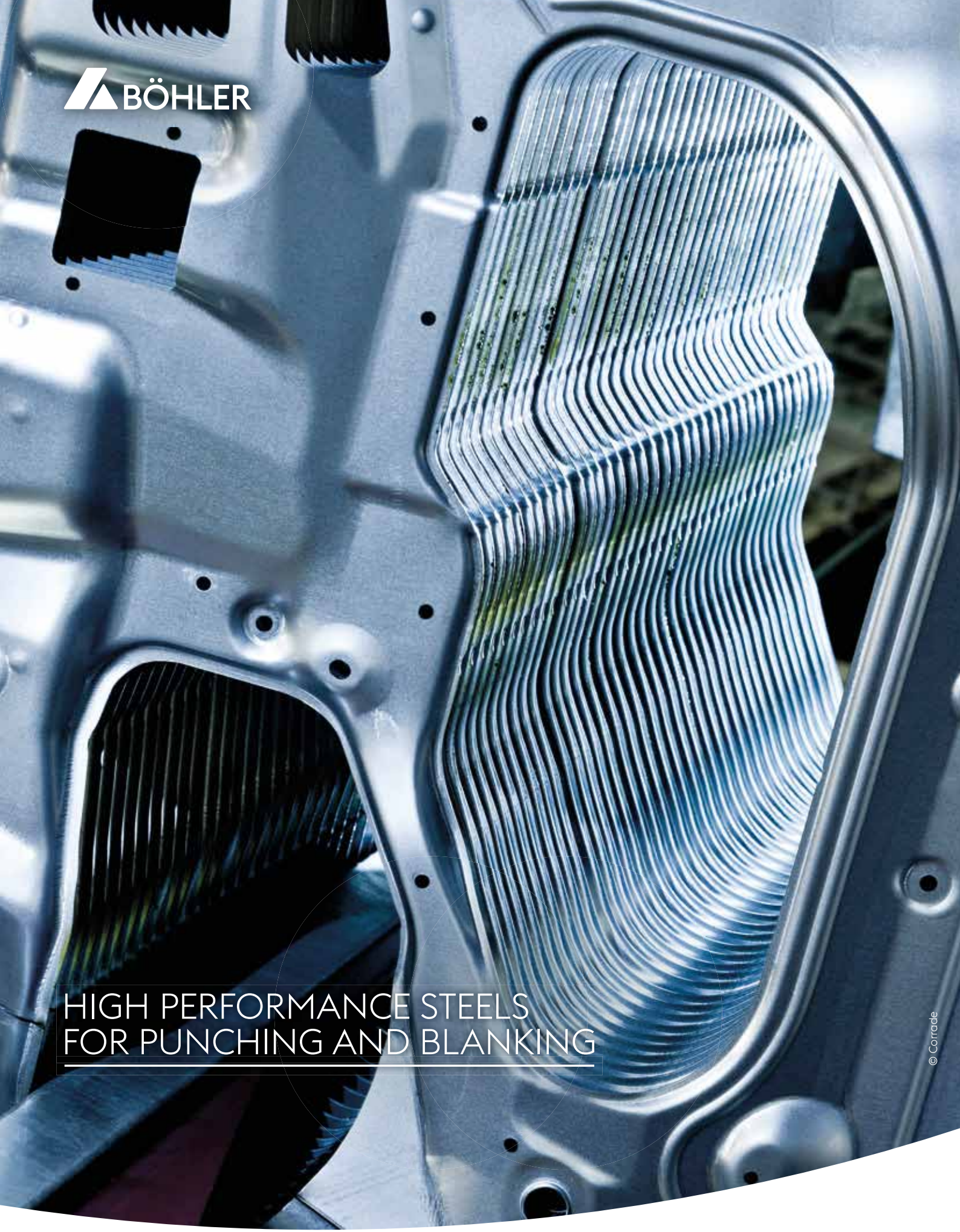

BÖHLER

HIGH PERFORMANCE STEELS FOR PUNCHING AND BLANKING

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voestalpine
ONE STEP AHEAD.

MADE-TO-MEASURE DIVERSITY FOR THE WORLD'S BEST

The requirements on **forming, cutting, punching and blanking tools** are constantly rising. Significantly longer service life is expected for tools today compared with just a few years ago, primarily due to continuously rising cost pressure. Consequently the requirements on tool steels are increasing.

BÖHLER offers a broad spectrum of made-to-measure products, along with essential expertise for application advice and coating technology.*

Depending on customer wishes and requirements profiles, we offer various options for the production of BÖHLER top grades with the following designations:

ISODUR®
Cold work tool steels – ESR/PESR

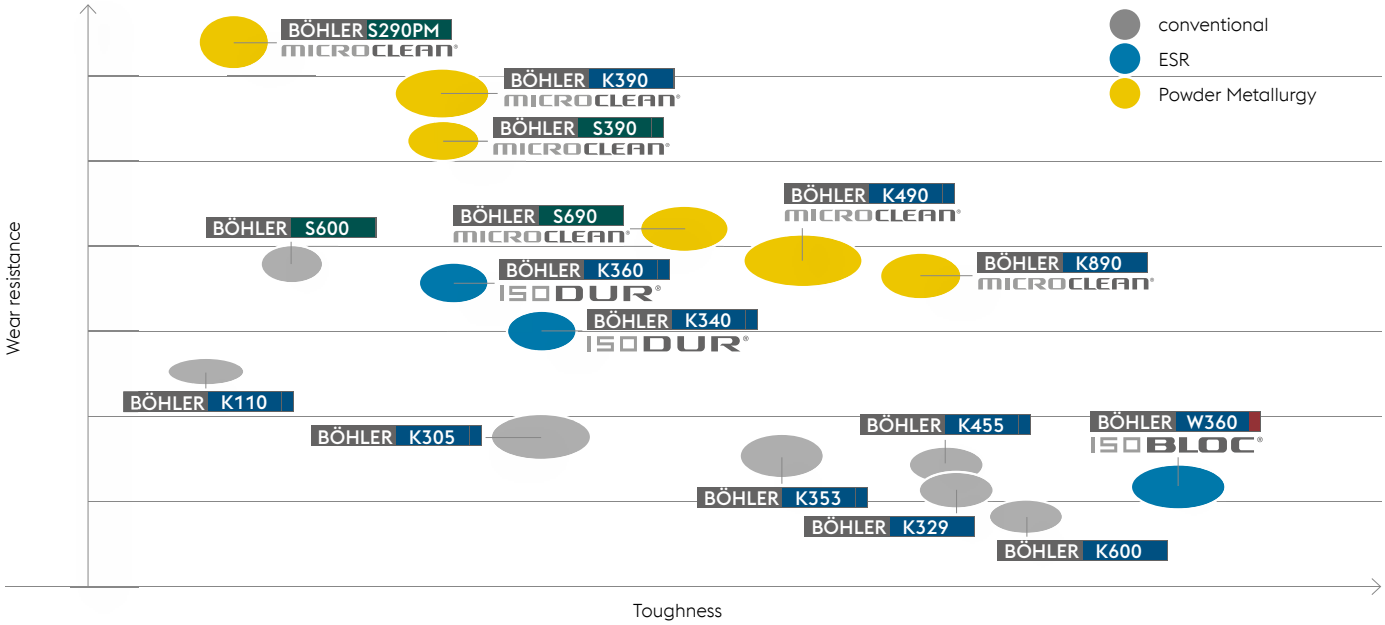
ISOBLOC®
Hot work tool steels – ESR/PESR

MICROCLEAN®
Powder metallurgical steels

* Fa. Eifeler

COMPARATIVE OVERVIEW OF BÖHLER TOP GRADES

Property profiles of BÖHLER cold work tool steels with various manufacturing technologies



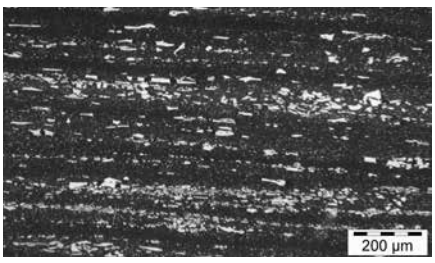
3 QUALITY LEVELS
3 TECHNOLOGIES

BASIC

Conventional production

Products made using the electric arc process are designated as conventionally melted materials and are the “basic materials” for ordinary loading, with the following primary properties:

» Banded carbide distribution
» Sufficient cleanliness



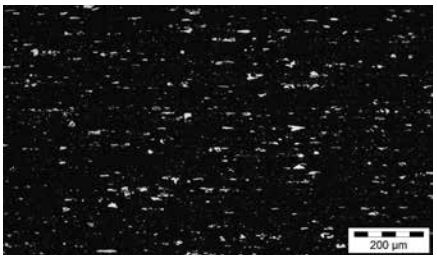
Micro structure of conventional 12% chromium steel

PREMIUM

ESR / PESR Manufacture

Products with improved properties can be produced using the ESR or PESR method. Using remelted materials leads to longer tool life due to:

» High level of cleanliness
» Low segregation
» Larger bar dimensions can be produced with the same carbide distribution
» Uniform dimensional changes
» Improved toughness



Microstructure of 8% chromium steel in ESR grade

SUPERIOR

Powder metallurgical production

Materials produced using powder metallurgy are increasingly being used to meet the most stringent requirements with various processing methods. These materials offer properties that meet demanding requirements:

» No segregation
» Extremely fine carbide distribution
» Homogeneous properties
» High wear resistance
» Very good dimensional stability
» High compressive strength
» High toughness with high hardness

Microstructure of PM materials

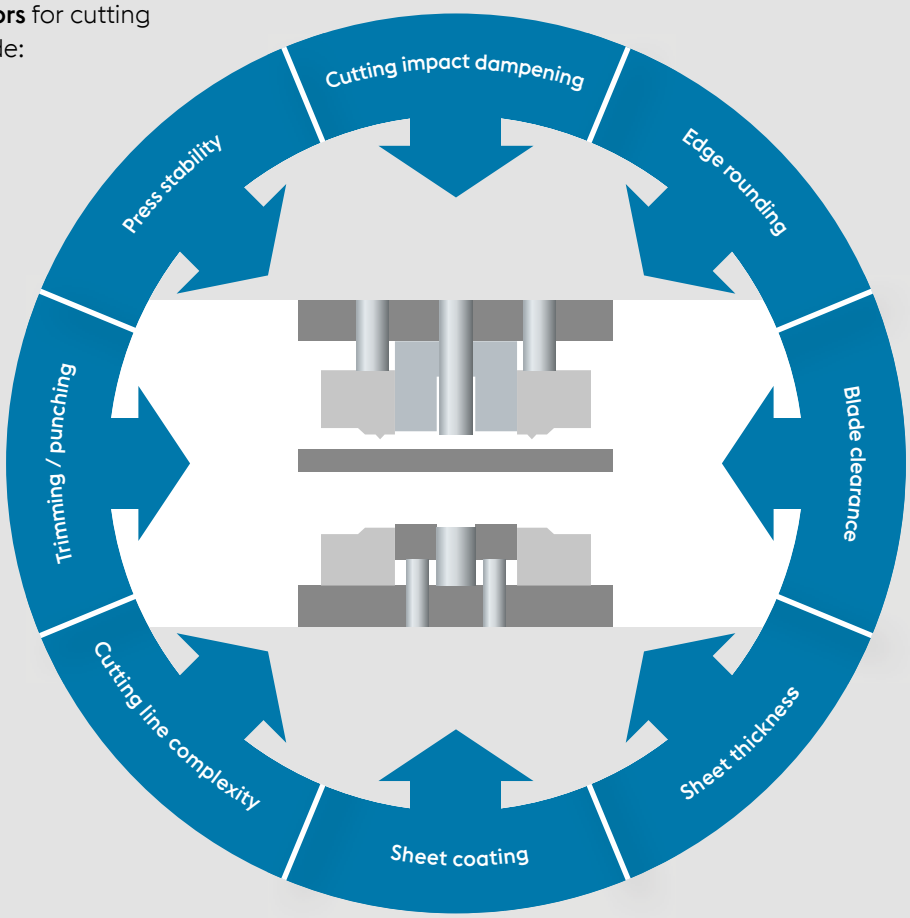
CUTTING AND STAMPING – MATERIAL REQUIREMENTS

Detailed knowledge of the stress factors in the manufacturing process is needed for selecting a tool material with optimal properties for the process concerned. On the other hand, various damage mechanisms should also be taken into account.

In many cases, conventional tool materials are not able to cope with the extremely high stresses sometimes encountered and are therefore not able to achieve the desired lifetimes.

As a cost-effective alternative, BÖHLER offers a variety of latest-generation materials with performance features precisely aligned to the desired application. Consistently high cutting and stamping performance yield the desired productivity gains.

The significant factors for cutting and stamping include:



REQUIREMENTS PROFILE

Tool life for cold forming is limited by wear and fatigue, which can lead to considerable downtime costs. By selecting a specific combination of matrix and carbides and a suitable cleanliness grade, BÖHLER offers top grades with properties that achieve optimal results in the relevant application and/or under the relevant stress conditions.

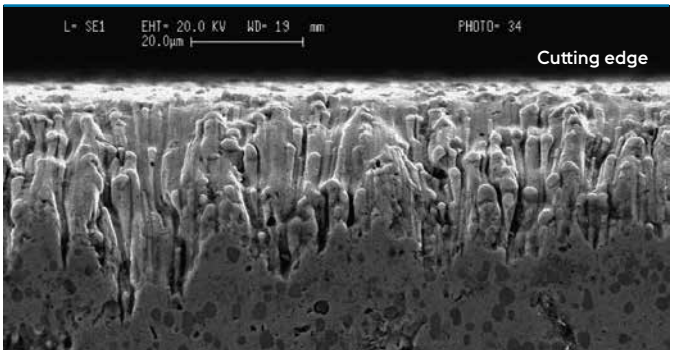
In cold forming operations, 80% of all tool failures in the production of simple high-volume parts are caused by wear.

DAMAGE MECHANISMS AND THEIR AVOIDANCE

ABRASIVE WEAR

Abrasion means material removal by gouging, cutting or chipping where two materials are in contact. In the case of cold forming tools, this primarily takes the form of erosion of the matrix of the tool material. Carbides retard this process.

Abrasive wear – matrix erosion

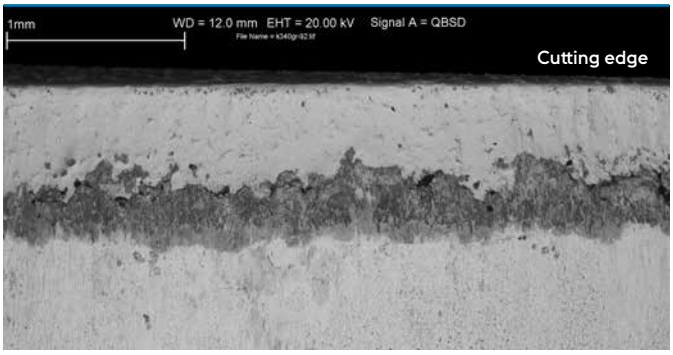


Potential solution:
Use a material with high carbide content and a high-strength matrix, such as BÖHLER K390 MICROCLEAN

ADHESIVE WEAR

Adhesion refers to the tendency to cold welding. Steels with high hardness and strength must be used to counter or prevent this tendency. The carbides embedded in the steel matrix reduce the tendency to adhesion, with a higher carbide content and more uniform carbide distribution both increasing the resistance to adhesive wear.

Adhesive wear – cold welding, material transfer

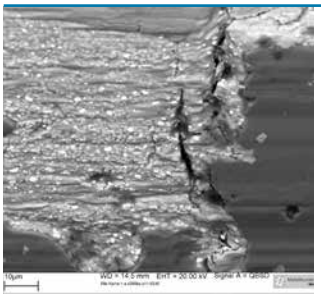


Potential solution:
Use a material with fine carbides, uniform distribution and a high-strength matrix, such as BÖHLER K340 ISODUR or use of coated tools

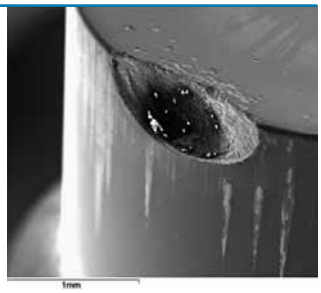
FATIGUE

Material fatigue means crack initiation and crack growth as a result of cyclic stress. Although tools for cold forming are usually pre-stressed under compression, fatigue fractures may occur under certain conditions, such as pressing operations.

Fatigue – spalling & plastic deformation



Tangential cracks



Edge chipping due to cyclic plastic deformation

Potential solution:

Use a material with fine, uniformly distributed carbides, high compressive strength and high purity, such as BÖHLER S390 MICROCLEAN

GOOD TO KNOW

Requirements for tool materials are becoming more demanding and more complex.

With expert product advice and a comprehensive product spectrum, BÖHLER is able to offer solutions individually tailored to your specific requirements and problems. The decision to use high-quality materials for your tooling often pays off quickly, since the material component of high-performance tooling often represents only 5% of the total value.

Cost-effectiveness result from:

» Better machining characteristics
» Longer life
» Lower maintenance costs
» Fewer tools
» Less downtime

In short:

BY USING RELIABLE TOOL MATERIALS, YOU SAVE TIME AND MONEY AND IMPROVE YOUR COMPETITIVENESS.

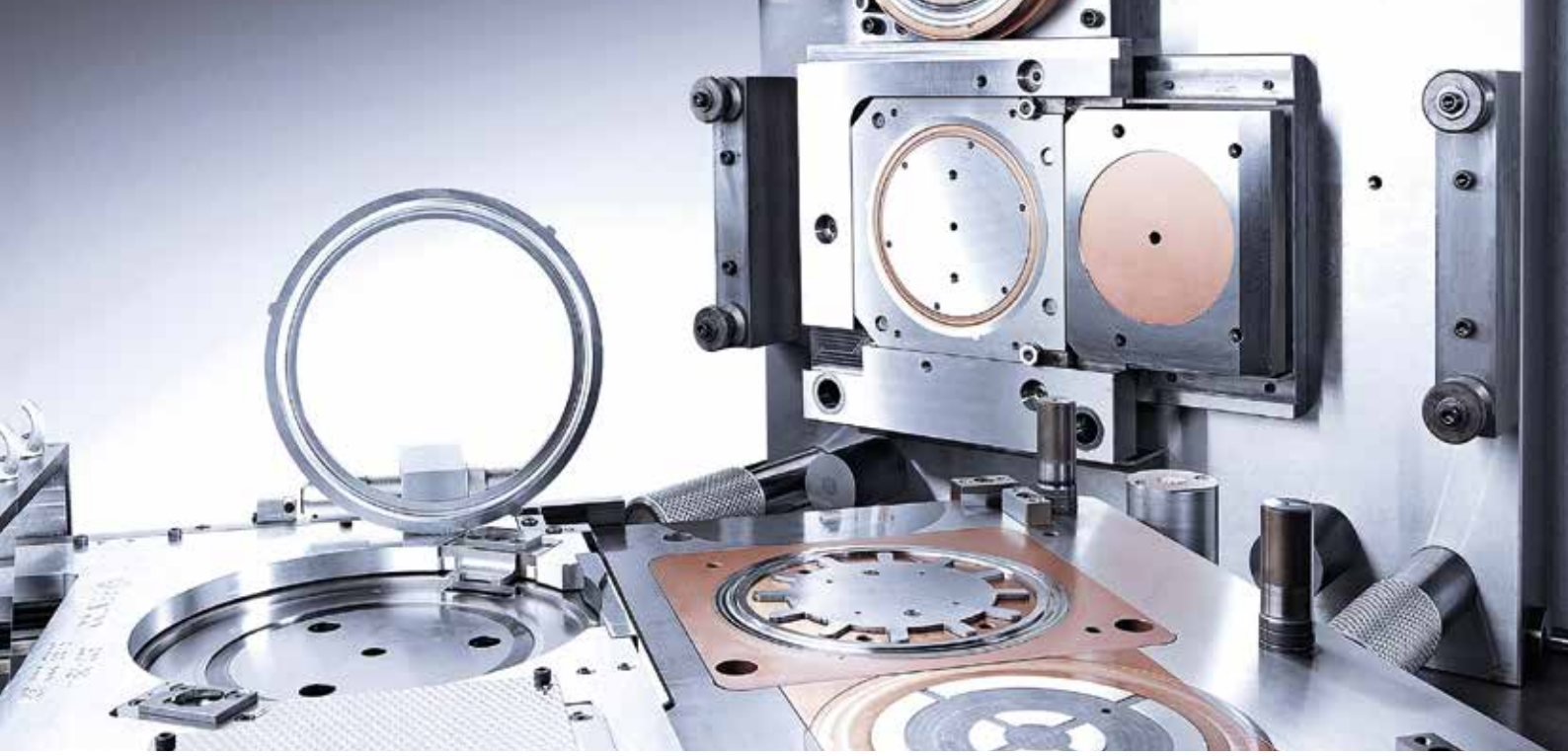
THE FULL DIVERSITY AT A GLANCE

CORE PRODUCTS

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 S600	0.90	4.10	5.00	1.80	6.40	–	1.3343 HS6-5-2	~ M2 reg.C
BÖHLER S630	0.95	4.00	4.00	2.00	4.00	+ Al	1.3330 HS4-4-2	–

BÖHLER grade	Chemical composition (nominal in wt.%)						Standards	
	C	Cr	Mo	V	W	Others	DIN / EN	AISI
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	–
BÖHLER W360 ISOBLOC®	0.50	4.50	3.00	0.55	–	–	Patented	–

BÖHLER grade	Chemical composition (nominal in wt.%)						Standards	
	C	Cr	Mo	V	W	Others	DIN / EN	AISI
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 S290 MICROCLEAN®	2.00	3.75	2.50	5.00	14.30	Co = 11.00	Patented	–
BÖHLER S390 MICROCLEAN®	1.60	4.80	2.00	5.00	10.50	Co = 8.00	–	–
BÖHLER S690 MICROCLEAN®	1.33	4.30	4.90	4.10	5.90	–	–	~ M4



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

Note:
The rating of the properties is based solely on stamping and cutting applications and the steels listed here. Comparative ratings are strongly dependent on specific heat treatment. For detailed advice on material selection, please consult your voestalpine BÖHLER dealer.

PROFITABLE MATERIAL RECOMMENDATIONS

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Steel sheet, plate & strip, aluminium and aluminium alloys, copper and copper alloys with tensile strength up to 600 MPa	up to 3 mm	BÖHLER K110	60	62
		BÖHLER K340 ISODUR®	60	63
		BÖHLER K360 ISODUR®	61	63
		BÖHLER K390 MICROCLEAN®	62	64
		BÖHLER S600	60	63
	3 – 6 mm	BÖHLER K110	58	62
		BÖHLER K305	58	62
		BÖHLER K340 ISODUR®	60	62
		BÖHLER K353	60	62
		BÖHLER K360 ISODUR®	60	62
		BÖHLER K390 MICROCLEAN®	61	63
		BÖHLER W360 ISOBLOC®	55	57
		BÖHLER K490 MICROCLEAN®	62	64
		BÖHLER K890 MICROCLEAN®	61	63
		BÖHLER S600	59	62
		BÖHLER S630	59	62
	6 – 12 mm	BÖHLER K340 ISODUR®	58	60
		BÖHLER K353	60	62
		BÖHLER K390 MICROCLEAN®	60	62
		BÖHLER W360 ISOBLOC®	54	56
		BÖHLER K455	52	56
		BÖHLER K490 MICROCLEAN®	61	63
		BÖHLER K890 MICROCLEAN®	60	62
	over 12 mm	BÖHLER K353	58	60
		BÖHLER W360 ISOBLOC®	50	54
		BÖHLER K490 MICROCLEAN®	58	60
		BÖHLER K600	52	54
		BÖHLER K890 MICROCLEAN®	58	60

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Steel sheet/plate & strip and metal alloys with tensile strength of 600 to 1000 MPa	up to 3 mm	BÖHLER K110	58	62
		BÖHLER K340 ISODUR	60	62
		BÖHLER K360 ISODUR	60	62
		BÖHLER K390 MICROCLEAN	61	63
		BÖHLER S600	59	62
		BÖHLER S630	59	62
	3 – 6 mm	BÖHLER K110	56	60
		BÖHLER K340 ISODUR	58	60
		BÖHLER K360 ISODUR	58	60
		BÖHLER K390 MICROCLEAN	60	62
		BÖHLER K490 MICROCLEAN	60	62
		BÖHLER K890 MICROCLEAN	60	62
	6 – 12 mm	BÖHLER K340 ISODUR	54	56
		BÖHLER K353	58	60
		BÖHLER K390 MICROCLEAN	58	60
		BÖHLER W360 ISOBLOC	52	54
		BÖHLER K455	50	54
		BÖHLER K490 MICROCLEAN	58	60
		BÖHLER K890 MICROCLEAN	58	60
	over 12 mm	BÖHLER K353	57	59
		BÖHLER W360 ISOBLOC	52	54
		BÖHLER K455	48	52
		BÖHLER K490 MICROCLEAN	58	60
		BÖHLER K600	48	52
		BÖHLER K890 MICROCLEAN	58	60

PROFITABLE MATERIAL RECOMMENDATIONS

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Precision blanking tools for metallic sheets and strips	up to 4 mm	BÖHLER K110	60	62
		BÖHLER K305	60	61
		BÖHLER K340 ISODUR®	61	63
		BÖHLER K353	60	62
		BÖHLER K360 ISODUR®	61	63
		BÖHLER K390 MICROCLEAN®	62	64
		BÖHLER K490 MICROCLEAN®	62	64
		BÖHLER S290 MICROCLEAN®	63	67
		BÖHLER S390 MICROCLEAN®	62	64
		BÖHLER S600	60	62
		BÖHLER S630	60	62
		BÖHLER S690 MICROCLEAN®	60	62
	4 - 8 mm	BÖHLER K110	58	60
		BÖHLER K305	58	60
		BÖHLER K340 ISODUR®	60	62
		BÖHLER K353	60	62
		BÖHLER K360 ISODUR®	60	62
		BÖHLER K390 MICROCLEAN®	61	63
		BÖHLER K490 MICROCLEAN®	61	63
		BÖHLER K890 MICROCLEAN®	60	63
		BÖHLER S390 MICROCLEAN®	61	64
		BÖHLER S600	59	62
		BÖHLER S630	59	62
		BÖHLER S690 MICROCLEAN®	60	62

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Precision blanking tools for metallic sheets and strips	8 - 12 mm	BÖHLER K340 ISODUR®	58	60
		BÖHLER K360 ISODUR®	58	60
		BÖHLER K390 MICROCLEAN®	60	62
		BÖHLER K490 MICROCLEAN®	60	62
		BÖHLER K890 MICROCLEAN®	59	62
		BÖHLER W360 ISOBLOC®	54	56
		BÖHLER S390 MICROCLEAN®	60	63
		BÖHLER S600	58	62
		BÖHLER S630	58	62
		BÖHLER S690 MICROCLEAN®	58	62
	over 12 mm	BÖHLER W360 ISOBLOC®	50	54
		BÖHLER K490 MICROCLEAN®	58	62
		BÖHLER K890 MICROCLEAN®	58	62
		BÖHLER S690 MICROCLEAN®	58	62

PROFITABLE MATERIAL RECOMMENDATIONS

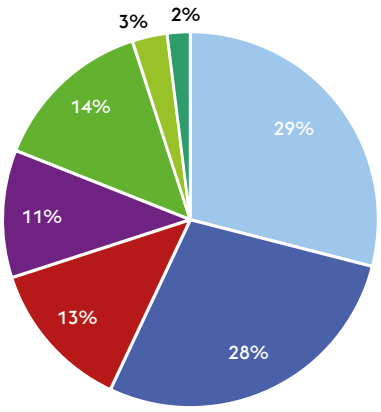
Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Sheets and strips for dynamos and transformers (highly abrasive)	up to 1 mm	BÖHLER K100	63	65
		BÖHLER K110	60	62
		BÖHLER K360 ISODUR®	61	63
		BÖHLER K390 MICROCLEAN®	62	64
		BÖHLER K490 MICROCLEAN®	62	64
		BÖHLER S290 MICROCLEAN®	63	68
		BÖHLER S390 MICROCLEAN®	62	66
		BÖHLER S690 MICROCLEAN®	62	64
	1 – 3 mm	BÖHLER K360 ISODUR®	59	62
		BÖHLER K390 MICROCLEAN®	61	63
		BÖHLER K490 MICROCLEAN®	60	63
		BÖHLER S390 MICROCLEAN®	61	63
	3 – 6 mm	BÖHLER K340 ISODUR®	58	60
		BÖHLER K390 MICROCLEAN®	60	62
		BÖHLER K490 MICROCLEAN®	60	63
		BÖHLER K890 MICROCLEAN®	60	63
		BÖHLER S390 MICROCLEAN®	60	62
Austenitic steels	up to 3 mm	BÖHLER K340 ISODUR®	60	62
		BÖHLER K353	60	62
		BÖHLER K360 ISODUR®	60	63
		BÖHLER K390 MICROCLEAN®	62	64
		BÖHLER K490 MICROCLEAN®	62	64
		BÖHLER S390 MICROCLEAN®	63	65
		BÖHLER S600	61	63
		BÖHLER S690 MICROCLEAN®	61	63

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Austenitic steels	3 – 6 mm	BÖHLER K340 ISODUR®	58	60
		BÖHLER K353	59	61
		BÖHLER K390 MICROCLEAN®	61	63
		BÖHLER K490 MICROCLEAN®	61	63
		BÖHLER K890 MICROCLEAN®	60	63
		BÖHLER S390 MICROCLEAN®	60	64
		BÖHLER S690 MICROCLEAN®	60	62
	6 – 12 mm	BÖHLER K340 ISODUR®	56	58
		BÖHLER K353	58	60
		BÖHLER W360 ISOBLOC®	54	56
		BÖHLER K390 MICROCLEAN®	58	60
		BÖHLER K490 MICROCLEAN®	59	61
		BÖHLER K890 MICROCLEAN®	60	62
		BÖHLER S390 MICROCLEAN®	58	60
		BÖHLER S690 MICROCLEAN®	58	60
	over 12 mm	BÖHLER K353	57	59
		BÖHLER W360 ISOBLOC®	54	56
		BÖHLER K490 MICROCLEAN®	58	60
		BÖHLER K890 MICROCLEAN®	58	60
		BÖHLER S690 MICROCLEAN®	58	60

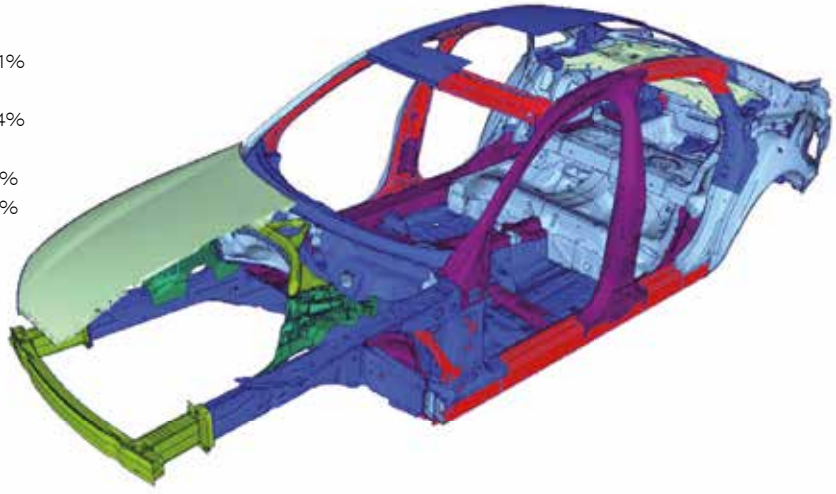
MACHINING OF HIGH-STRENGTH AND ULTRA HIGH-STRENGTH SHEETS

APPLICATION

The share of high-strength and ultra high-strength sheet metal in vehicle construction is strongly rising. BÖHLER offers a broad spectrum of grades to provide the optimum solution for demanding maching tasks

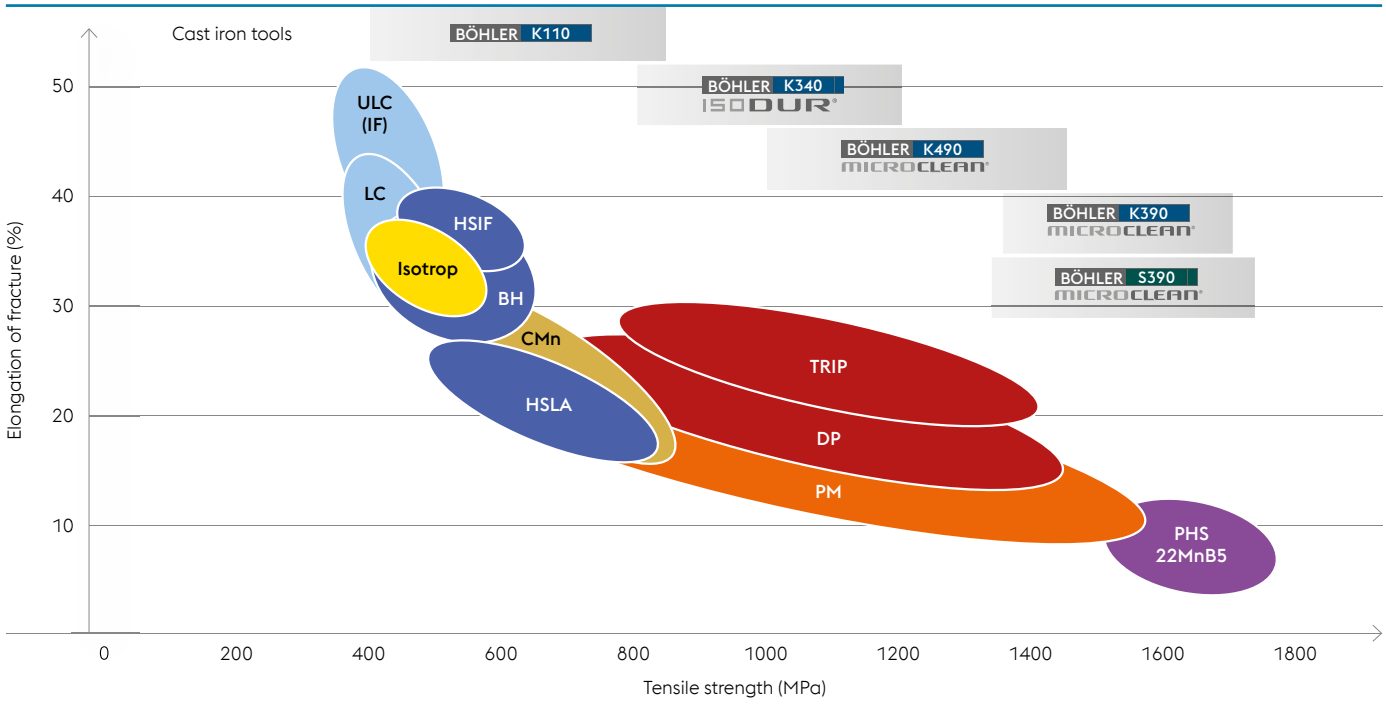


- **Low-strength steels:** Mild steels — 29%
- **High-strength steels (HSS):** 28%
  High-strength interstitial-free steels (HSIF), Bake hardening steels (BH), High-strength low alloy steels (HSLA)
- **Advanced high-strength steels (AHSS):** 13%
  Dual phase steels (DP), Transformation induced plasticity steels (TRIP)
- **Stainless steels:** Austenitic stainless steels
- **Ultra high-strength steels (UHSS):**
  Complex phase steels (CP), Martensitic steels (MS)
- **Press hardened steels (PHS)** — 11%
- **Aluminium sheets:** 7xxx series
- **Aluminium sheets:** 6xxx series — 14%
- **Aluminium sheets:** 5xxx series
- **Aluminium extrusion profiles** — 3%
- **Cast aluminium** — 2%



MATERIALS FOR CUTTING, PUNCHING AND BLANKING HIGH-STRENGTH AND ULTRA-HIGH 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		

PROFITABLE MATERIAL RECOMMENDATIONS

Material to be cut	Material thickness	BÖHLER grade	Standard hardness of punches and dies in HRc	
			Complex shapes and/or thick sheets	Simple shapes and/or thin sheets
Steel sheet/plate and strip and metal alloys with tensile strengths over 1000 MPa	up to 2 mm	BÖHLER K340 ISODUR®	60	62
		BÖHLER K360 ISODUR®	60	62
		BÖHLER K390 MICROCLEAN®	62	64
		BÖHLER K490 MICROCLEAN®	62	64
		BÖHLER K890 MICROCLEAN®	60	64
		BÖHLER S390 MICROCLEAN®	62	64
		BÖHLER S600	60	62
		BÖHLER S690 MICROCLEAN®	60	64
	over 2 mm	BÖHLER K340 ISODUR®	58	60
		BÖHLER W360 ISOBLOC®	55	57
		BÖHLER K490 MICROCLEAN®	60	62
		BÖHLER K890 MICROCLEAN®	60	64
		BÖHLER S390 MICROCLEAN®	60	62
		BÖHLER S600	60	62
		BÖHLER S690 MICROCLEAN®	60	64

The formability and ductility of all of the materials mentioned above decrease with increasing hardening phases.

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