

PLASTIC MOULD STEELS

Tool steels for plastic processing

FORM FOLLOWS FUNCTION

A BÖHLER TOOL STEEL IS THE OPTIMUM ANSWER TO ANY APPLICATION IN THE MANUFACTURE OF PLASTIC MOULD PARTS, MEETING THE INCREASED EXPECTATIONS OF USERS AS REGARDS SHAPE, FUNCTION, ESTHETICS, PRODUCT QUALITY AND DURABILITY. AFTER ALL, A PRODUCT IS ONLY AS GOOD AS IS THE MOULD IN WHICH IT IS PRODUCED.

MICROCLEAN®

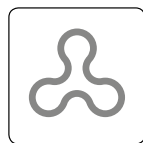
Powder metallurgy high performance steels

ISOPLAST®

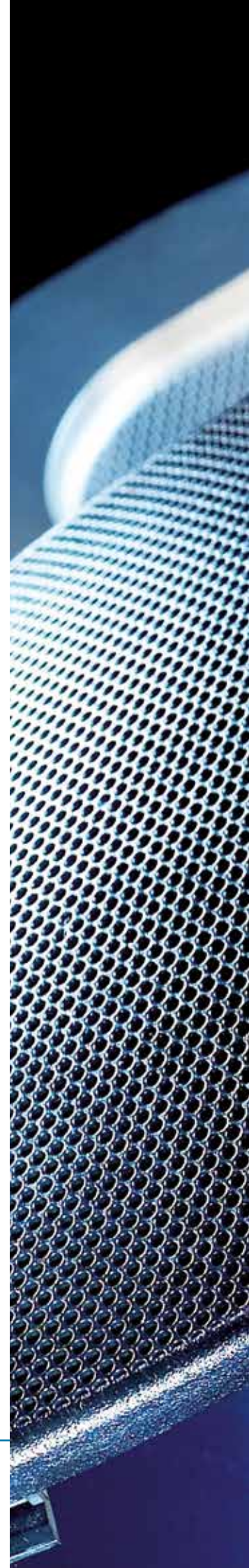
Plastic mould steels in ESR quality

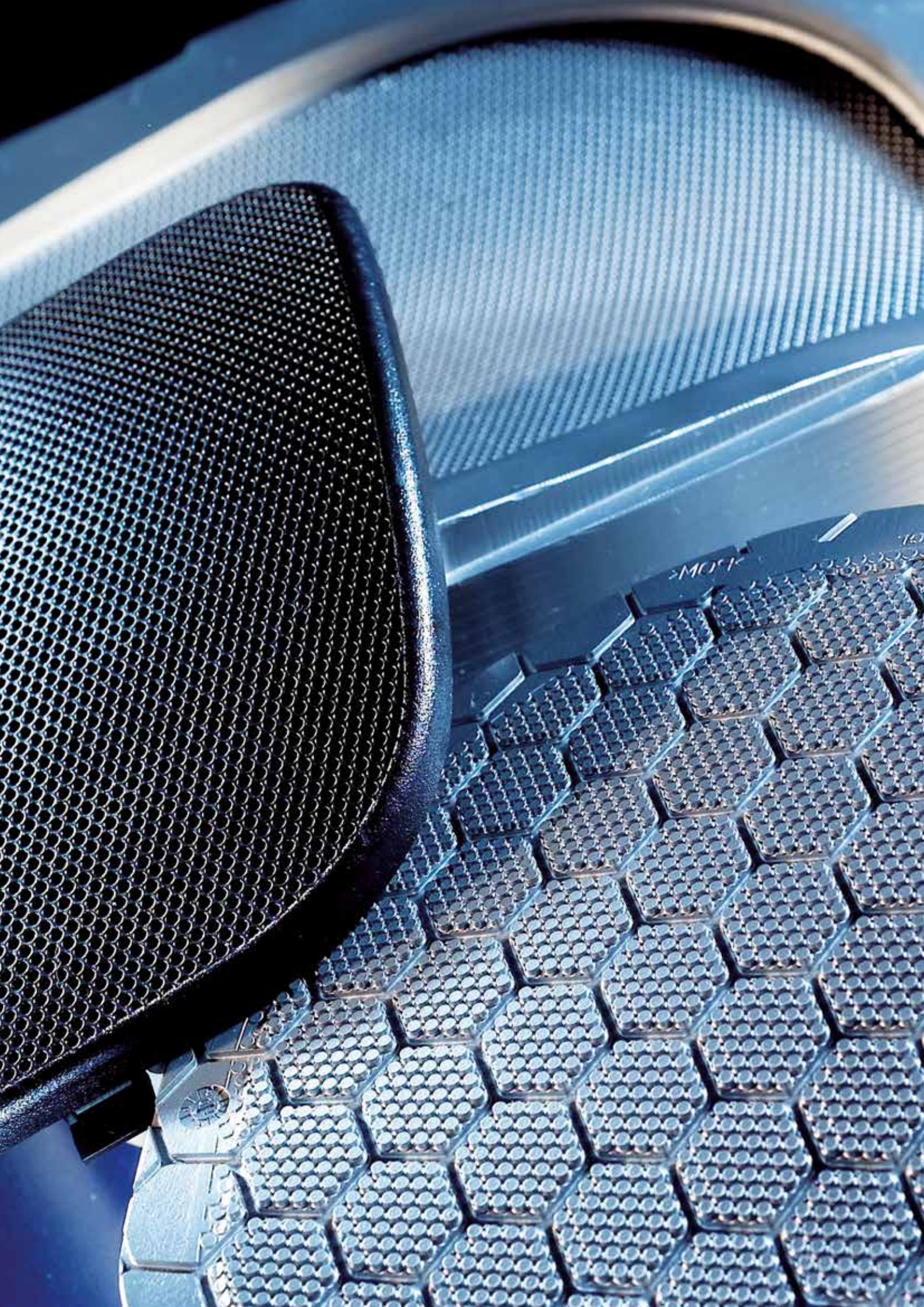
VMR®

Tool steels subjected to vacuum refining or melting during at least one stage of manufacture.



PLASTIC MOULD
STEEL





TOOL MAKERS REQUIRE THE BEST MACHINABILITY

As a tool maker you certainly know of all the demands a product should fulfill. BÖHLER, therefore, gives you recommendations on the steel and its properties for best meeting your requirements.

BÖHLER steels are of a guaranteed consistent quality to be delivered to the plastic processing industry and exhibit a variety of production grades and qualities tailor-made to meet your demands.

You as a toolmaker want to have	Material Properties
Economic manufacturing, especially if a high degree of machining is necessary	Excellent machinability
Best polishability	High cleanliness
Uncomplicated, consistent manufacturing process	Steel of consistent quality
Optimum grainability	Homogenous materials properties
Individual materials development	Extensive metallurgical knowledge, consultancy services





OUR SERVICES INCLUDE COMPETENT MATERIAL CONSULTING PAIRED WITH INNOVATIVE AND FLEXIBLE CO-OPERATION IN DEVELOPING SPECIFIC PLASTIC MOULD STEELS. AND EVERYTHING IS TAILOR-MADE.



YOU AS A PLASTIC PROCESSOR
COUNT ON THE HIGHEST TOOL SERVICE LIFE FIRST
AND FOREMOST TO BE ABLE TO PRODUCE CONSISTENTLY
HIGH QUALITY AT HIGH PROCESS SECURITY.





MANUFACTURERS REQUIRE THE HIGHEST QUALITY

BÖHLER Plastic Mould Steels excel in their properties such as excellent thermal conductivity, corrosion resistance and the highest wear resistance with an optimum dimensional accuracy, hardness, toughness and compressive strength. If required we also offer a combination of all these qualities including a good repair weldability, low maintenance

and servicing and consistent quality, resulting in the highest possible profitability. Our long-standing experience, innovative research and development and our intense co-operation with some plastic processors enable us to provide you with exactly the steel which best meets any chemical and mechanical requirements.



You as a plastic processor want to have Assured by	
Long tool life	High wear resistance
Short cycle times	Best thermal conductivity
Resistant to corrosive influences, therefore less service and maintenance necessary	Best corrosion resistance
Consistent tool quality	Best hardness and toughness properties and compressive strength

MOST FREQUENTLY USED STEELS

The choice of steels reflects the variety of demands with respect to materials properties and takes into account the different situations in which the tools are used:

- » Corrosion resistant steels
- » Powder metallurgy steels
- » Heat treated steels
- » Case hardening steels
- » Through-hardenable tool steels

BÖHLER grade	Chemical composition in %						Standards	
	C	Cr	Mo	Ni	V	Others	DIN / EN	AISI

CORROSION RESISTANT STEELS

BÖHLER M303  ¹⁾ EXTRA	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 >	40CrMn-MoS8-6	~ P20
BÖHLER M238 	0.38	2.00	0.20	1.10	–	Mn = 1.50	< 1.2738 >	40CrMnNi-Mo8-6-4	–
BÖHLER M238  HIGH HARD	0.38	2.00	0.20	1.10	–	Mn = 1,50	< 1.2738 >	40CrMnNi-Mo8-6-4	–
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 >	40CrMnNi-Mo8-6-4	–

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

OTHER COMMONLY USED STEELS

BÖHLER grade	Chemical composition in %						Standards		
	C	Cr	Mo	Ni	V	Others	DIN / EN	AISI	

CORROSION RESISTANT STEELS

BÖHLER N685 ³⁾	0,90	17,50	1,10	–	0,10	–	< 1.4112 >	X90CrMoV18	~ 440B
BÖHLER N700 ⁴⁾	0,04	15,40	–	4,40	–	Cu = 3,30 Nb = 0,30	< 1.4542 >	X5CrNi- CuNb16-4	630

POWDER METALLURGY STEELS

BÖHLER K390 MICROCLEAR	2,50	4,00	4,00	–	9,00	W = 1,00 Co = 2,00	–	–	–
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ALLOYED TOOL STEELS

BÖHLER K110 ⁵⁾	1,55	11,80	0,80	–	0,95	–	< 1.2379 >	X155CrV- Mo12-1	D2
BÖHLER K340 ISODUR	1,10	8,30	2,10	–	0,50	Si = 0,90			
BÖHLER K360 ISODUR	1,25	8,75	2,70	–	1,18	Si = 0,90			
BÖHLER K600 ¹⁾	0,45	1,30	0,25	4,00	–	–	< 1.2767 >	X45NiCrMo4	–
BÖHLER W300 ²⁾ ISOBLOC	0,36	5,00	1,30	–	0,40	Si = 1,10	< 1.2343 >	X38CrMoV5-1	H11
BÖHLER W302 ²⁾ ISOBLOC	0,39	5,20	1,40	–	0,95	Si = 1,10	< 1.2344 >	X40CrMoV5-1	H13
BÖHLER W350 ISOBLOC	0,38	5,00	1,75	–	0,55	Si = 0,20	–	–	–
BÖHLER W360 ISOBLOC	0,50	4,50	3,00	–	0,55	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	Si = 0,20	~ 1.2367		

¹⁾ also available in conventional quality

²⁾ also available in ISODISC quality

³⁾ also available in ISOEXTRA quality

⁴⁾ also available in conventional and VMR quality

⁵⁾ also available in ISODUR quality

CORROSION RESISTANT STEELS

The processing of plastics which contain chemically aggressive or abrasive fillers demands hardenable, corrosion-resistant steels. This reduces the mould maintenance necessary in comparison to steels which are less corrosion resistant. This group of steels is divided into two types:

HARDENABLE STEELS

Steels which are delivered in the soft annealed condition and usually hardened to over 50 HRC after machining.



BÖHLER grade	Corrosion resistance ¹⁾	Wear resistance	Toughness	Polishability ²⁾	Machinability in as-supplied condition	Supplied condition
HARDENABLE, CORROSION-RESISTANT STEELS						
BÖHLER M310 	★★★★	★★	★★	★★★	★★★★	W max. 225 HB
BÖHLER M333 	★★★★★	★★	★★★★★	★★★★★	★★★★	W max. 220 HB
BÖHLER M340 	★★★	★★★	★★	★★	★★★	W max. 260 HB
BÖHLER M368 	★★★★	★★★	★★★	★★★★	★★★	W max. 260 HB
BÖHLER M390 	★★	★★★★★	★★	★★★	★	W max. 280 HB
BÖHLER N685 	★	★★★★	★	★	★★	W max. 265 HB

¹⁾ high tempered, weight loss test with 20 % boiling acetic acid, 24h

²⁾ Rating worked out with polishing expert JOKE Technologies

W soft annealed

The profiles given are characteristic of each group of steels.



PRE-HEAT-TREATED STEELS

Steels which are supplied and used in the heat-treated condition. The hardness of approx. 30 HRC (similar to the non-corrosion-resistant heat-treatable steels) is an optimum

compromise between machinability and wear resistance / compressive strength. In special cases, a higher working hardness may be used.

BÖHLER grade	Corrosion resistance ¹⁾	Wear resistance	Toughness	Polishability ²⁾	Machinability in as-supplied condition	Supplied condition
HEAT TREATED, CORROSION RESISTANT STEELS						
BÖHLER M303 EXTRA	★★★★	★★★	★★★★	★★★★	★★★	V ca. 1000 N/mm ²
BÖHLER M303 EXTRA HIGH HARD	★★★	★★★★	★★★	★★★★★	★★	V ca. 40 HRC
BÖHLER M314	★★	★★	★★	★★	★★★★	V ca. 1000 N/mm ²
BÖHLER M315 EXTRA	★★	★★	★★	★	★★★★★	V ca. 1000 N/mm ²
BÖHLER N700	★★★★★	★★★★★	★★★★★	★★★	★★	V ca. 1150 N/mm ²

¹⁾high tempered, weight loss test with 20 % boiling acetic acid, 24h

²⁾Rating worked out with polishing expert JOKE Technologies

V hardened and tempered to obtain good mechanical properties

The profiles given are characteristic of each group of steels.

POWDER METALLURGICAL STEELS

Powder metallurgical steels are used when an extremely long tool life is required and therefore wear resistance and hardness are important. These materials are used primarily for extruder screws and back-flow check valves, but also in the processing of fibre-reinforced plastics. Corrosion resistant variants are available with the grades BÖHLER M368 and M390 MICROCLEAN.

Particular advantages are:

- » High hardness and compressive strength
- » Good dimensional stability during heat treatment
- » High wear resistance



BÖHLER grade	Corrosion resistance ¹⁾	Wear resistance	Toughness	Polishability ²⁾	Machinability in as-supplied condition	Supplied condition
BÖHLER M368 MICROCLEAN®	★★★★	★★	★★★★★	★★★★★	★★★	W max. 260 HB
BÖHLER M390 MICROCLEAN®	★★	★★★★	★★★	★★★★	★★	W max. 280 HB
BÖHLER K390 MICROCLEAN®	not applicable	★★★★★	★★★★	★★★★	★★	W max. 280 HB

¹⁾ high tempered, weight loss test with 20 % boiling acetic acid, 24h

²⁾ Rating worked out with polishing expert JOKE Technologies

W soft annealed

The profiles given are characteristic of each group of steels.



PRE-HEAT TREATED STEELS



The development of ever-larger plastic parts places increasing importance on the correct heat treatment of the moulds. In order to eliminate dimensional changes and quench cracking, pre-heat-treated steels are used for large tools. They are heat-treated to a hardness of 290 – 400 HB / approx. 30 – 43 HRC by the manufacturer. At this hardness, the steel retains its good machinability

but still has a good wear resistance and adequate strength.

Particular advantages of pre-heat treated steels are:

- » No need to heat treat after machining
- » Can be used as supplied even in large dimensions

BÖHLER grade	Wear resistance	Toughness	Polishability ^{*)}	Machinability in as-supplied condition	Through-hardenable	Grainability	Supplied condition
BÖHLER M200	★★	★★	★★	★★★★★	★	★★	V 290 – 330 HB
BÖHLER M238	★★	★★★★	★★★	★★★	★★★★	★★★	V 290 – 330 HB
BÖHLER M238 HIGH HARD	★★★★	★★★	★★★★	★★	★★★★	★★★★	V ca. 40 HRC (HIGH HARD)
BÖHLER M268 VMR®	★★★★	★★★★★	★★★★★	★★	★★★★	★★★★★	V ca. 40 HRC (HIGH HARD)
BÖHLER M261 EXTRA	★★★	★★	★★★	★★★★	★★★	★★	LA ca. 40 HRC

^{*)} Rating worked out with polishing expert JOKE Technologies

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.

ALLOYED TOOL STEELS

Due to specific properties and combinations of properties these steels can be used as an alternative to or in addition to other steels where corrosion resistance is not required.



BÖHLER grade	Wear resistance	Toughness	Polishability ^{*)}	Machinability in as-supplied condition	Supplied condition
WEAR-RESISTANT, NON-CORROSION-RESISTANT STEELS					
BÖHLER K110	★★★★	★	★	★★	W max. 250 HB
BÖHLER K340 ISODUR®	★★★★	★★	★★	★★★	W max. 235 HB
BÖHLER K360 ISODUR®	★★★★	★★	★★	★★★	W max. 250 HB
BÖHLER K390 MICROCLEAN®	★★★★★	★★	★★★★★	★	W max. 280 HB
BÖHLER K600	★★	★★★★	★★★★★	★★	W max. 260 HB
HOT WORK STEELS					
BÖHLER W300 ISO BLOC®	★	★★★★	★★★	★★★★★	W max. 205 HB
BÖHLER W302 ISO BLOC®	★★	★★★★	★★	★★★★★	W max. 205 HB
BÖHLER W350 ISO BLOC®	★★	★★★★	★★★★★	★★★★★	W max. 205 HB
BÖHLER W360 ISO BLOC®	★★	★★★★	★★★★★	★★★★	W max. 205 HB
BÖHLER W400 VMR®	★	★★★★★	★★★★★	★★★★	W max. 205 HB
BÖHLER W403 VMR®	★★	★★★★	★★★★★	★★★★	W max. 205 HB

^{*)} Rating worked out with polishing expert JOKE Technologies

W soft annealed

The profiles given are characteristic of each group of steels.

CASE- HARDENING STEELS

Case-hardening steels are hardened by carburising the surface, i.e. they are characterised by a very high surface hardness (approx. 62HRC) combined with a tough centre. Due to their excellent polishability, these steels are particularly suited for use as smaller moulds and inserts.

BÖHLER grade	Wear resistance	Toughness	Polishability	Machinability in as-supplied condition	Supplied condition
BÖHLER M100	★★★	★★★	★★★★	★★★★	W max. 205 HB
BÖHLER M130	★★★	★★★★	★★★★	★★★	W max. 250 HB

W soft annealed

The profiles given are characteristic of each group of steels.



APPLICATIONS

Tool	Specific requirements	BÖHLER grade	DIN / EN Material no.	Strength or hardness in use
Mould, mould insert	good corrosion resistance, good wear resistance		~ 1.2316	V = approx. 1000 N/mm ²
			~ 1.2316	V = approx. 40 HRc
			~ 1.2083	H + A = 48 – 52 HRc
	good corrosion resistance, good thermal conductivity and high polishability		–	H + A = 48 – 50 HRc
	no heat treatment (supplied preheat treated), high hardness, good machinability		–	precipitation hardened approx. 40 HRc
	no heat treatment, good polishability, good machinability, good photoetching properties (except for BÖHLER M200), high strength, high toughness		< 1.2312 >	V = approx. 1000 N/mm ²
			< 1.2738 >	V = approx. 1000 N/mm ²
			< 1.2738 >	V = approx. 40 HRc
	no heat treatment, best polishability, due to HH-version and VMR-remelted, reduced cycle-times due to improved thermal conductivity.		< 1.2738 >	V = approx. 40 HRc
	highest toughness, air hardenability, good compressive strength		< 1.2767 >	H + A = approx. 52 HRc
			< 1.2340 >	H + A = approx. 50 HRc V = 1000 – 1300 N/mm ²
			~ 1.2367	H + A = ca. 50 HRc V = 1000 – 1300 N/mm ²
			< 1.2344 >	H + A = approx. 50 HRc V = 1000 – 1300 N/mm ²
			–	H + A = ca. 50 HRc V = 1000 – 1300 N/mm ²
			–	H + A = approx. 50 - 56 HRc
	high surface hardness, cold hobbing properties, high toughness		< 1.2162 >	core strength 1200 – 1500 N/mm ²
			< 1.2764 >	core strength 1200 – 1500 N/mm ²

Tool	Specific requirements	BÖHLER grade	DIN / EN Material no.	Strength or hardness in use
Mould, mould insert, screws	excellent corrosion resistance, very good wear resistance, good hardenability		-	H + A = 48 – 55 HRC
			-	H + A = 48 – 55 HRC
	maximum wear resistance, good hardenability		-	H + A = 58 – 62 HRC
	good corrosion resistance (except for K 390 Microclean)		-	H + A = 56 – 62 HRC
Mould carrier form	excellent machinability, high strength, good corrosion resistance		< 1.2085 >	V = approx. 1000 N/mm ²
			-	V = approx. 1000 N/mm ²
Sprue nozzles	good wear resistance		< 1.2344 >	V = approx. 1000 N/mm ² surface hardness (nitrided) 900 HV
			-	H + A = approx. 50 - 56 HRC
	maximum wear resistance, good corrosion resistance		-	H + A = 53 – 56 HRC
Backflow valves	high wear resistance		< 1.2379 >	H + A = approx. 55 HRC
	maximum wear resistance, good hardenability		-	H + A = 58 – 62 HRC
			-	H + A = 58 – 62 HRC
Guide ring, mounting plate, ejector plate, ejector pin, retainer plate	good machinability		< 1.1730 >	600 – 700 N/mm ²
			< 1.2312 >	V = approx. 1000 N/mm ²
			< 1.2738 >	V = approx. 1000 N/mm ²
			< 1.2738 >	V = approx. 40 HRC
Ejector pins			< 1.2344 >	V = approx. 1500 N/mm ²
			< 1.2510 >	H + A = approx. 50 – 56 HRC

V hardened and tempered to obtain good mechanical properties
H + A quenched and tempered for obtaining high hardness



FLOW OF MATERIAL

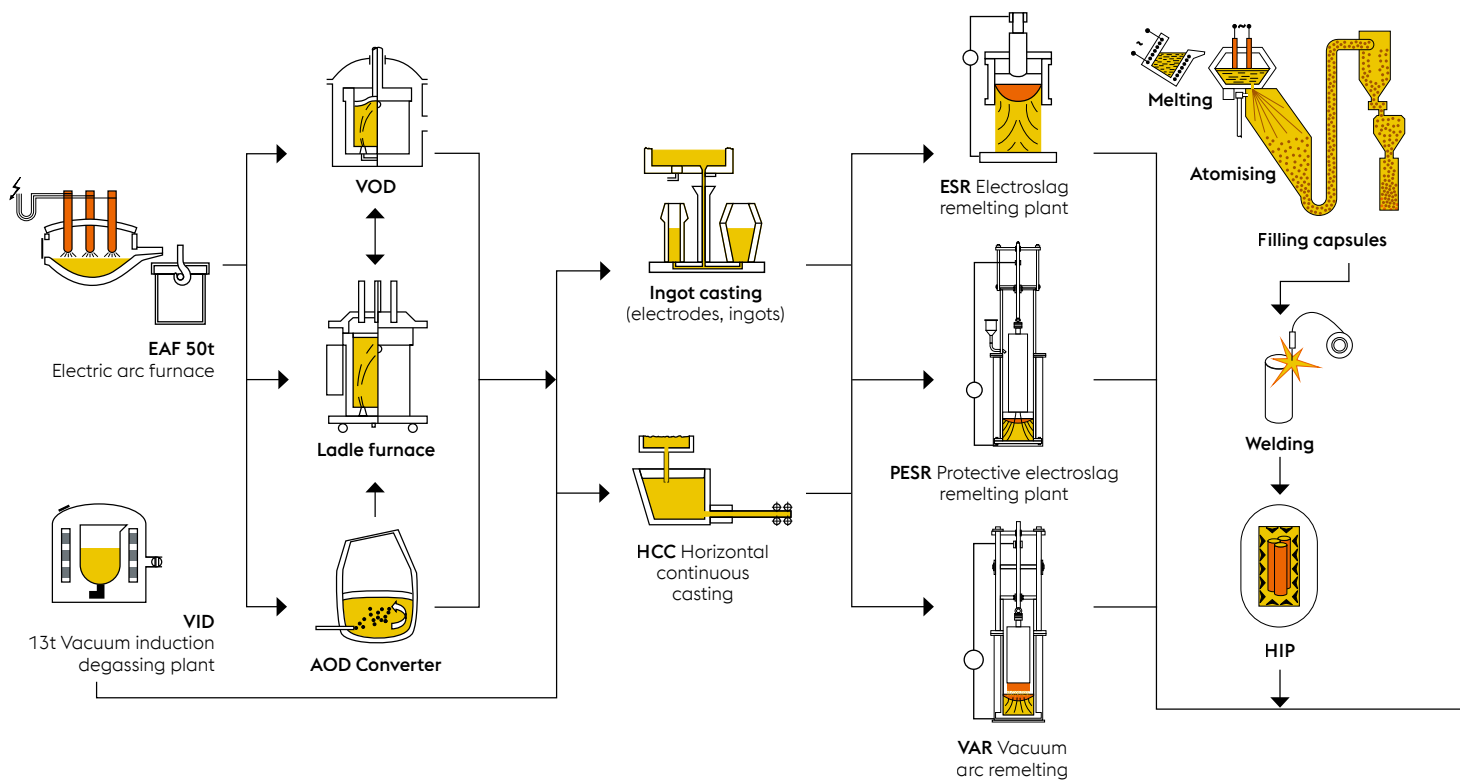
→ MELTING

→ SECONDARY METALLURGY

→ CASTING

→ REMELTING

→ POWDER-METALLURGY





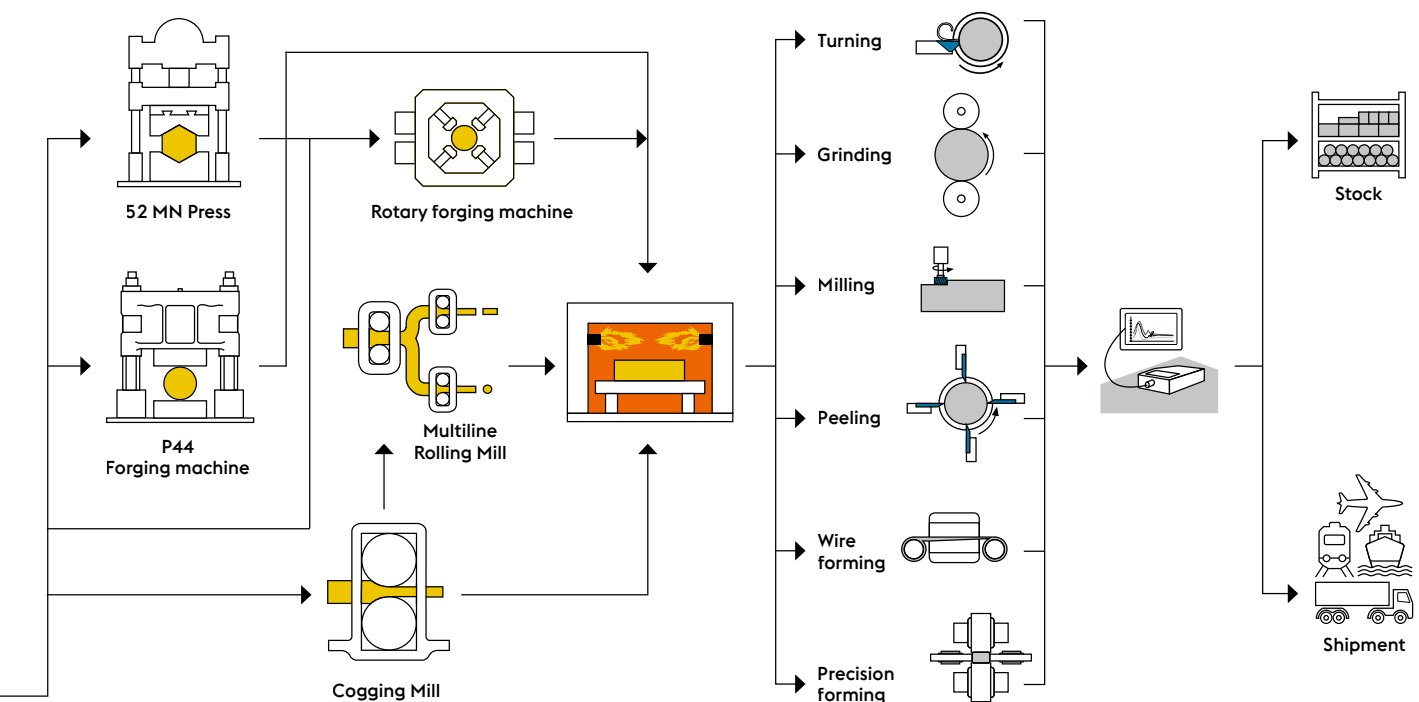
→ ROLLING AND FORGING

→ HEAT TREATMENT

→ MACHINING

→ TESTING

→ DISPATCH



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

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ONE STEP AHEAD.