

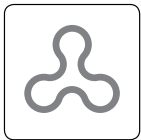


# PLASTIC MOULD STEELS

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, AESTHETICS, PRODUCT QUALITY AND DURABILITY. AFTER ALL, A PRODUCT IS ONLY AS GOOD AS IS THE MOULD IN WHICH IT IS PRODUCED.



PLASTIC  
MOULD STEEL

## **MICROCLEAN®**

Powder Metallurgy high performance steels

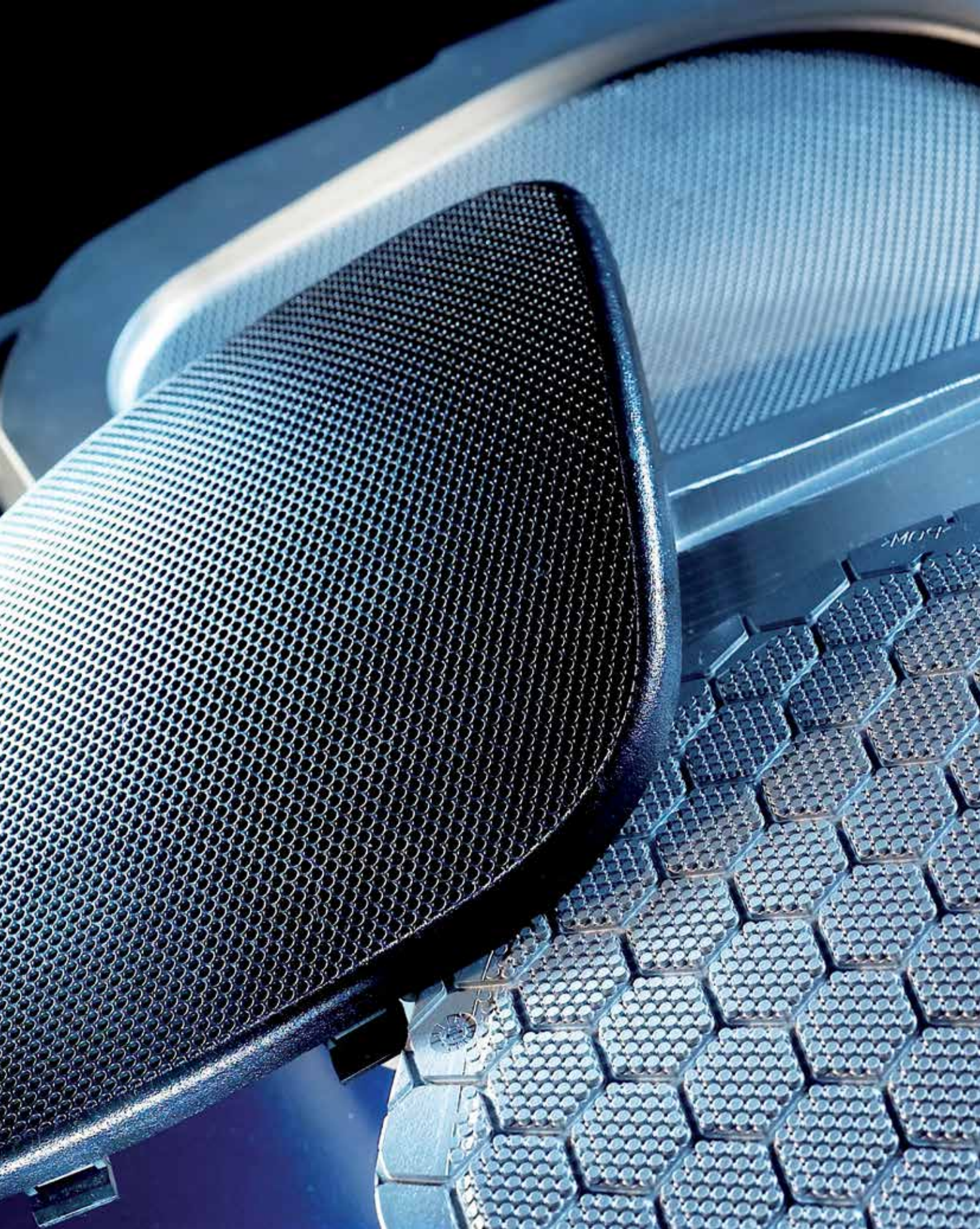
## **ISOPLAST®**

Plastic Mould Steels in ESR quality

## **VMR®**

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





# 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.

<b>You as a toolmaker want to have</b>	<b>Material Properties</b>
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**

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Long tool life

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High wear resistance

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Short cycle times

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Best thermal conductivity

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Resistant to corrosive influences,  
therefore less service and  
maintenance necessary

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Best corrosion resistance

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Consistent tool quality

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Best hardness and toughness  
properties and compressive strength

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

<sup>1)</sup> also available as ESR-grade



## OTHER COMMONLY USED STEELS

BÖHLER Grade	Chemical composition in %						Standards	
	C	Cr	Mo	Ni	V	Others	DIN/ EN	AISI
<b>CORROSION RESISTANT STEELS</b>								
<b>BÖHLER N685</b> <sup>3)</sup>	0.90	17.50	1.10	–	0.10	–	< 1.4112 > X90CrMoV18	~ 440B
<b>BÖHLER N700</b> <sup>4)</sup>	0.04	15.40	–	4.40	–	Cu = 3.30 Nb = 0.30	< 1.4542 > X5CrNiCuNb16-4	630
<b>POWDER METALLURGY STEELS</b>								
<b>BÖHLER K390</b> <b>MICROCLEAR</b>	2.50	4.00	4.00	–	9.00	W = 1.00 Co = 2.00	–	–
<b>ALLOYED TOOL STEELS</b>								
<b>BÖHLER K110</b> <sup>5)</sup>	1.55	11.80	0.80	–	0.95	–	< 1.2379 > X155CrVMo12-1	D2
<b>BÖHLER K340</b> <b>ISODUR</b>	1.10	8.30	2.10	–	0.50	Si = 0.90	–	–
<b>BÖHLER K360</b> <b>ISODUR</b>	1.25	8.75	2.70	–	1.18	Si = 0.90	–	–
<b>BÖHLER K600</b> <sup>1)</sup>	0.45	1.30	0.25	4.00	–	–	< 1.2767 > X45NiCrMo4	–
<b>BÖHLER W300</b> <sup>2)</sup> <b>ISOBLOC</b>	0.36	5.00	1.30	–	0.40	Si = 1.10	< 1.2343 > X38CrMoV5-1	H11
<b>BÖHLER W302</b> <sup>2)</sup> <b>ISOBLOC</b>	0.39	5.20	1.40	–	0.95	Si = 1.10	< 1.2344 > X40CrMoV5-1	H13
<b>BÖHLER W350</b> <b>ISOBLOC</b>	0.38	5.00	1.75	–	0.55	Si = 0.20	–	–
<b>BÖHLER W360</b> <b>ISOBLOC</b>	0.50	4.50	3.00	–	0.55	Si = 0.20	–	–
<b>BÖHLER W400</b> <b>VMR</b>	0.36	5.00	1.30	–	0.45	Si = 0.20	< 1.2340 >	~ H11
<b>BÖHLER W403</b> <b>VMR</b>	0.38	5.00	2.80	–	0.65	Si = 0.20	~ 1.2367	–

<sup>1)</sup> also available in conventional quality

<sup>2)</sup> also available in ISODISC quality

<sup>3)</sup> also available in ISOEXTRA quality

<sup>4)</sup> also available in conventional and VMR quality

<sup>5)</sup> 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 <sup>1)</sup>	Wear resistance	Toughness	Polishability <sup>2)</sup>	Machinability in as-supplied condition	Supplied condition
<b>BÖHLER M310</b> ISOPLAST®	★★★★	★★	★★	★★★	★★★★	W max. 225 HB
<b>BÖHLER M333</b> ISOPLAST®	★★★★★	★★	★★★★★	★★★★★	★★★★	W max. 220 HB
<b>BÖHLER M340</b> ISOPLAST®	★★★	★★★	★★	★★	★★★	W max. 260 HB
<b>BÖHLER M368</b> MICROCLEAN®	★★★★	★★★	★★★	★★★★	★★★	W max. 260 HB
<b>BÖHLER M390</b> MICROCLEAN®	★★	★★★★★	★★	★★★	★	W max. 280 HB
<b>BÖHLER N685</b>	★	★★★★	★	★	★★	W max. 265 HB

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

<sup>2)</sup> 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 <sup>1)</sup>	Wear resistance	Toughness	Polishability <sup>2)</sup>	Machinability in as-supplied condition	Supplied condition
<b>HEAT TREATED, CORROSION RESISTANT STEELS</b>						
<b>BÖHLER M303 EXTRA</b>	★★★★	★★★	★★★★	★★★★	★★★	V approx. 1000 N/mm <sup>2</sup>
<b>BÖHLER M303 EXTRA HIGH HARD</b>	★★★	★★★★	★★★	★★★★★	★★	V approx. 40 HRc
<b>BÖHLER M314</b>	★★	★★	★★	★★	★★★★★	V approx. 1000 N/mm <sup>2</sup>
<b>BÖHLER M315 EXTRA</b>	★★	★★	★★	★	★★★★★	V approx. 1000 N/mm <sup>2</sup>
<b>BÖHLER N700</b>	★★★★★	★★★★★	★★★★★	★★★	★★	V approx. 1150 N/mm <sup>2</sup>

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

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

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

<sup>2)</sup> 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
- » High wear resistance

BÖHLER grade	Wear resistance	Toughness	Polishability <sup>*)</sup>	Machinability in as-supplied condition	Through-hardenable	Grainability	Supplied condition
<b>BÖHLER M200</b>	★★	★★	★★	★★★★★	★	★★	V 290 – 330 HB
<b>BÖHLER M238</b>	★★	★★★★	★★★	★★★	★★★★	★★★	V 290 – 330 HB
<b>BÖHLER M238</b> HIGH HARD	★★★★	★★★	★★★★	★★	★★★★	★★★★	V approx. 40 HRc (HIGH HARD)
<b>BÖHLER M268</b> VMR®	★★★★	★★★★★	★★★★★	★★	★★★★	★★★★★	V approx. 40 HRc (HIGH HARD)
<b>BÖHLER M261</b> EXTRA	★★★	★★	★★★	★★★★	★★★	★★	LA approx. 40 HRc

<sup>\*)</sup> 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 <sup>*)</sup>	Machinability in as-supplied condition	Supplied condition
<b>WEAR-RESISTANT, NON-CORROSION-RESISTANT STEELS</b>					
<b>BÖHLER K110</b>	★★★★	★	★	★★	W max. 250 HB
<b>BÖHLER K340</b> <b>ISODUR®</b>	★★★★	★★	★★	★★★	W max. 235 HB
<b>BÖHLER K360</b> <b>ISODUR®</b>	★★★★	★★	★★	★★★	W max. 250 HB
<b>BÖHLER K390</b> <b>MICROCLEAN®</b>	★★★★★	★★	★★★★	★	W max. 280 HB
<b>BÖHLER K600</b>	★★	★★★★	★★★★★	★★	W max. 260 HB
<b>HOT WORK STEELS</b>					
<b>BÖHLER W300</b> <b>ISOBLOC®</b>	★	★★★★	★★★	★★★★★	W max. 205 HB
<b>BÖHLER W302</b> <b>ISOBLOC®</b>	★★	★★★★	★★	★★★★★	W max. 205 HB
<b>BÖHLER W350</b> <b>ISOBLOC®</b>	★★	★★★★	★★★★	★★★★★	W max. 205 HB
<b>BÖHLER W360</b> <b>ISOBLOC®</b>	★★	★★★★	★★★★	★★★★	W max. 205 HB
<b>BÖHLER W400</b> <b>VMR®</b>	★	★★★★★	★★★★★	★★★★	W max. 205 HB
<b>BÖHLER W403</b> <b>VMR®</b>	★★	★★★★	★★★★★	★★★★	W max. 205 HB

<sup>\*)</sup> 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

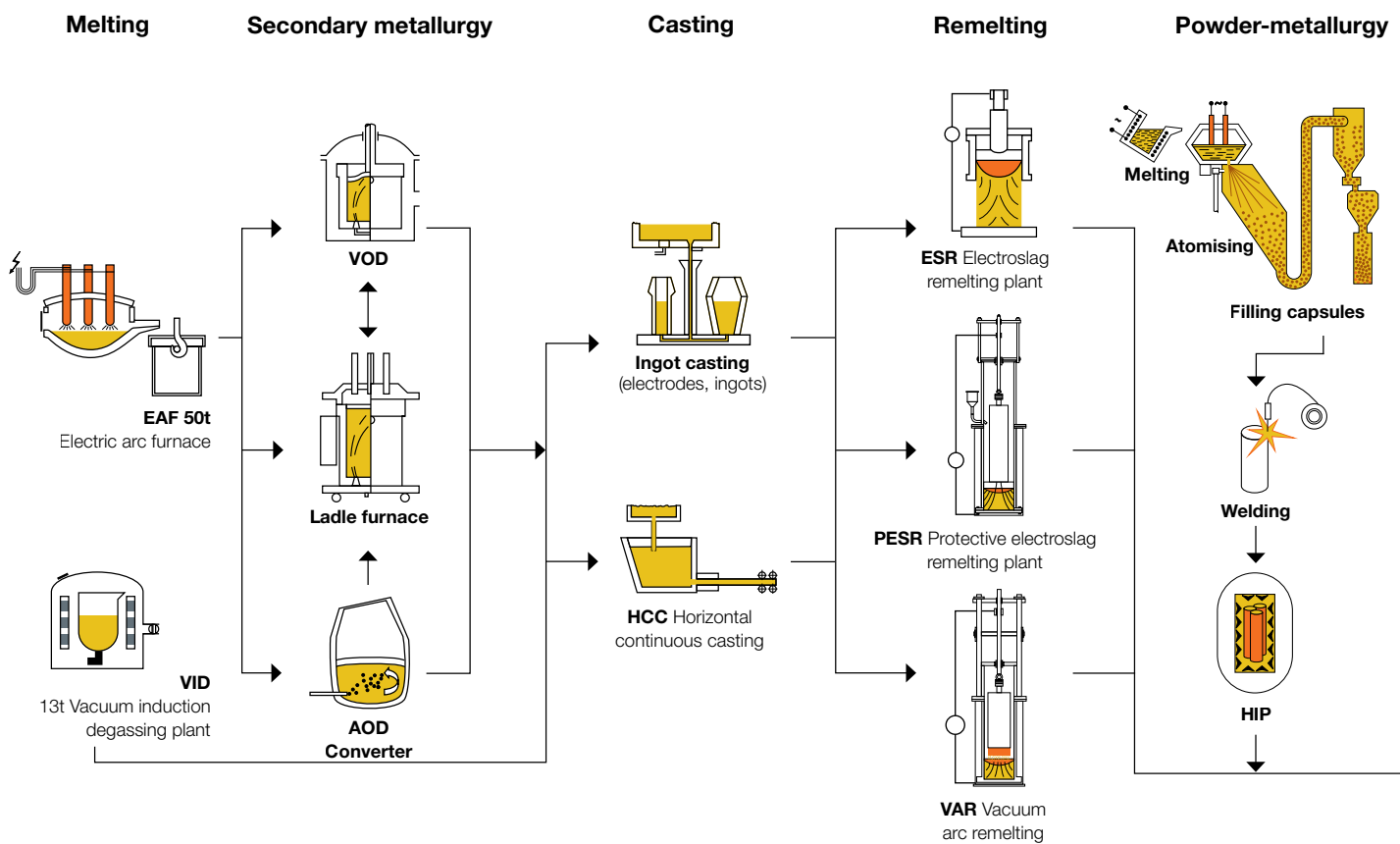
Tool	Specific requirements	BÖHLER grade	DIN / EN Material no.	Strength or hardness in use
Mould, mould insert	good corrosion resistance, good wear resistance	<b>BÖHLER M303</b> <b>EXTRA</b>	~ 1.2316	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M303</b> <b>EXTRA</b> HIGH HARD	~ 1.2316	V = approx. 40 HRc
		<b>BÖHLER M310</b> <b>ISOPLAST</b>	~ 1.2083	H + A = 48 – 52 HRc
	good corrosion resistance, good thermal conductivity and high polishability	<b>BÖHLER M333</b> <b>ISOPLAST</b>	-	H + A = 48 – 50 HRc
	no heat treatment (supplied preheat treated), high hardness, good machinability	<b>BÖHLER M261</b> <b>EXTRA</b>	-	precipitation hardened approx. 40 HRc
	no heat treatment, good polishability, good machinability, good photoetching properties (except for BÖHLER M200), high strength, high toughness	<b>BÖHLER M200</b>	< 1.2312 >	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M238</b>	< 1.2738 >	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M238</b> HIGH HARD	< 1.2738 >	V = approx. 40 HRc
	no heat treatment, best polishability, due to HH-version and VMR-re melted, reduced cycle-times due to improved thermal conductivity.	<b>BÖHLER M268</b> <b>VMR</b>	< 1.2738 >	V = approx. 40 HRc
	highest toughness, air hardenability, good compressive strength	<b>BÖHLER K600</b>	< 1.2767 >	H + A = approx. 52 HRc
		<b>BÖHLER W400</b> <b>VMR</b>	< 1.2340 >	
		<b>BÖHLER W403</b> <b>VMR</b>	~ 1.2367	H + A = approx. 50 HRc V = 1000 – 1300 N/mm <sup>2</sup>
		<b>BÖHLER W302</b> <b>ISOBLOC</b>	< 1.2344 >	H + A = approx. 50 HRc V = 1000 – 1300 N/mm <sup>2</sup>
		<b>BÖHLER W350</b> <b>ISOBLOC</b>	-	H + A = approx. 50 HRc V = 1000 – 1300 N/mm <sup>2</sup>
		<b>BÖHLER W360</b> <b>ISOBLOC</b>	-	H + A = approx. 50 - 56 HRc
	high surface hardness, cold hobbing properties, high toughness	<b>BÖHLER M100</b>	< 1.2162 >	core strength 1200 – 1500 N/mm <sup>2</sup>
		<b>BÖHLER M130</b>	< 1.2764 >	core strength 1200 – 1500 N/mm <sup>2</sup>



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	<b>BÖHLER M340</b> <b>ISOPLAST</b>	-	H + A = 48 – 55 HRc
		<b>BÖHLER M368</b> <b>MICROCLEAN</b>	-	H + A = 48 – 55 HRc
	maximum wear resistance, good hardenability	<b>BÖHLER K390</b> <b>MICROCLEAN</b>	-	H + A = 58 – 62 HRc
	good corrosion resistance (except for K 390 Microclean)	<b>BÖHLER M390</b> <b>MICROCLEAN</b>	-	H + A = 58 – 62 HRc
Mould carrier form	excellent machinability, high strength, good corrosion resistance	<b>BÖHLER M314</b>	< 1.2085 >	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M315</b> <b>EXTRA</b>	-	V = approx. 1000 N/mm <sup>2</sup>
Sprue nozzles	good wear resistance	<b>BÖHLER W302</b> <b>ISOBLOC</b>	< 1.2344 >	V = approx. 1000 N/mm <sup>2</sup> surface hardness (nitrided) 900 HV
		<b>BÖHLER W360</b> <b>ISOBLOC</b>	-	H + A = approx. 50 - 56 HRc
	maximum wear resistance, good corrosion resistance	<b>BÖHLER M390</b> <b>MICROCLEAN</b>	-	H + A = 53 – 56 HRc
Backflow valves	high wear resistance	<b>BÖHLER K110</b>	< 1.2379 >	H + A = approx. 55 HRc
	maximum wear resistance, good hardenability	<b>BÖHLER K390</b> <b>MICROCLEAN</b>	-	H + A = 58 – 62 HRc
		<b>BÖHLER M390</b> <b>MICROCLEAN</b>	-	H + A = 58 – 62 HRc
Guide ring, mounting plate, ejector plate, ejector pin, retainer plate	good machinability	<b>BÖHLER K945</b>	< 1.1730 >	600 – 700 N/mm <sup>2</sup>
		<b>BÖHLER M200</b>	< 1.2312 >	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M238</b>	< 1.2738 >	V = approx. 1000 N/mm <sup>2</sup>
		<b>BÖHLER M238</b> <b>HIGH HARD</b>	< 1.2738 >	V = approx. 40 HRc
Ejector pins		<b>BÖHLER W302</b>	< 1.2344 >	V = approx. 1500 N/mm <sup>2</sup>
		<b>BÖHLER W360</b> <b>ISOBLOC</b>	< 1.2510 >	H + A = approx. 50 – 56 HRc



# FLOW OF MATERIAL





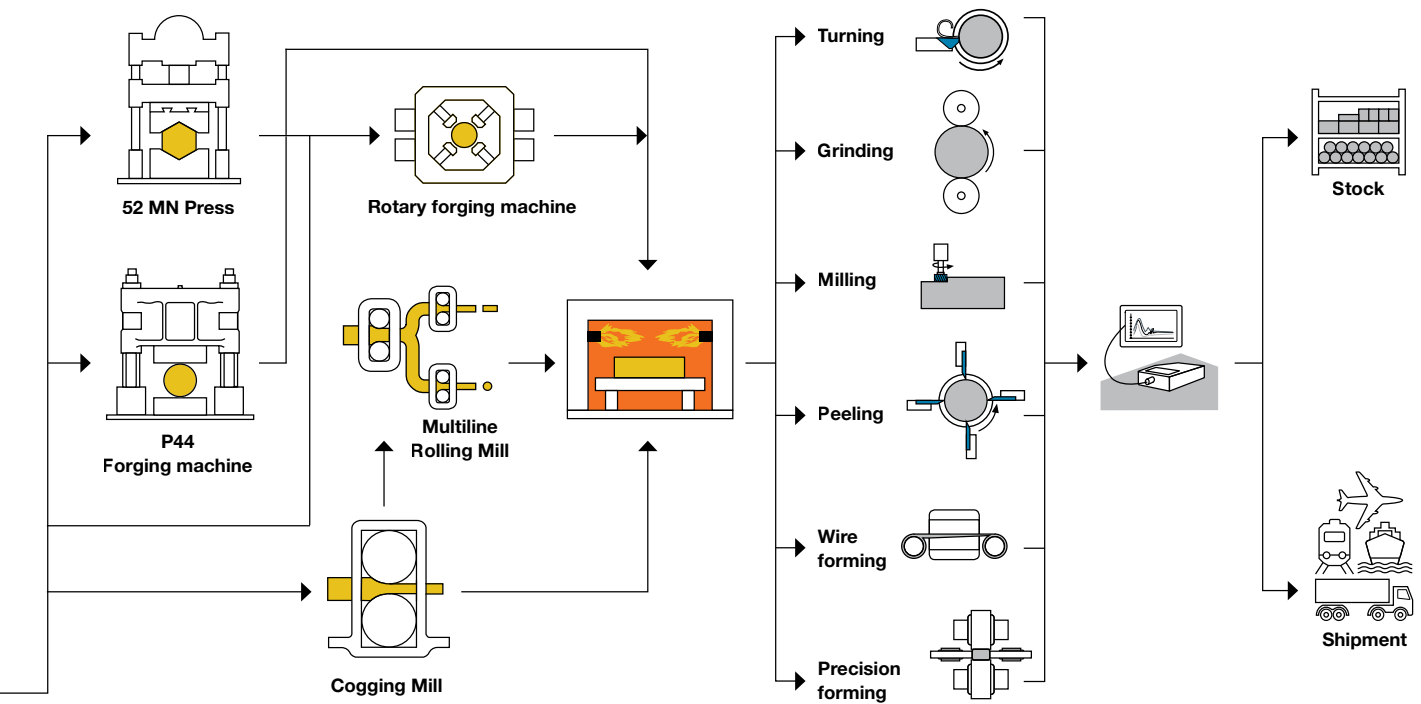
**Rolling and forging**

**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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