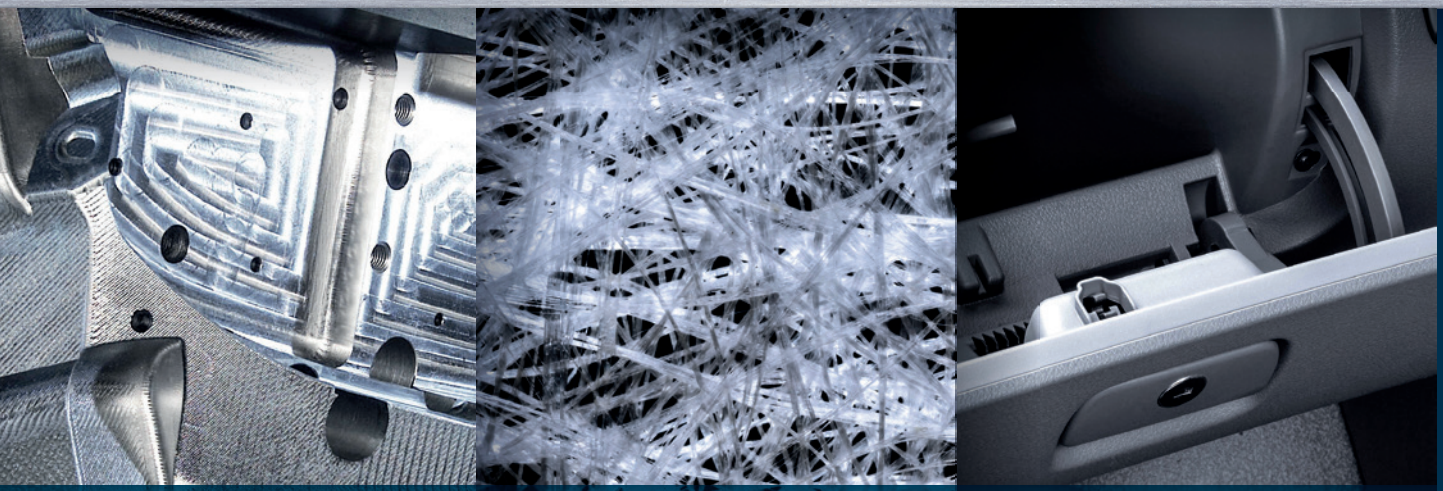
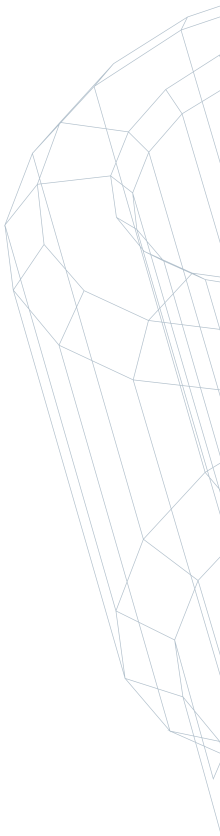
BÖHLER



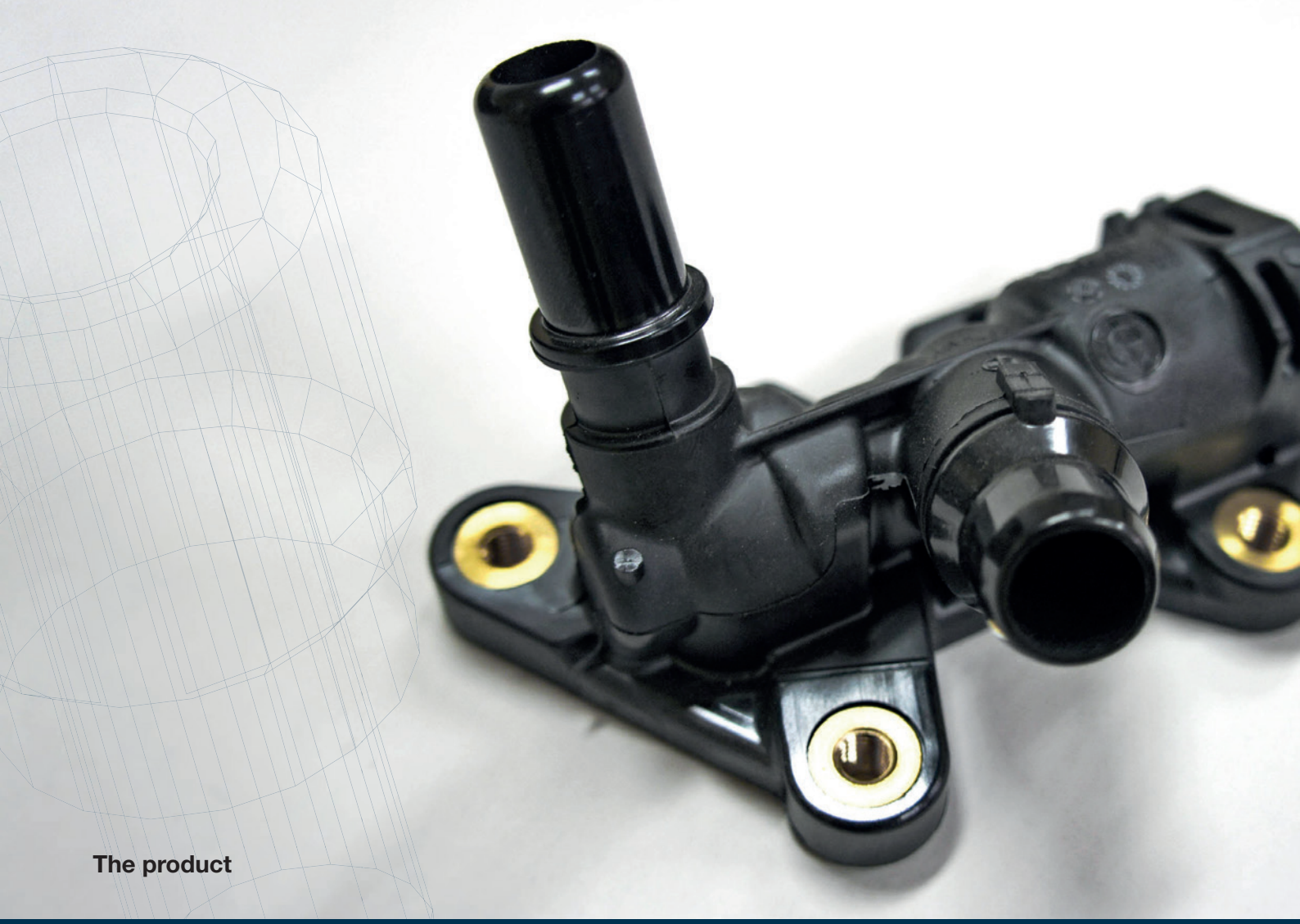
HIGH PERFORMANCE MOLD STEELS FOR INJECTION OF REINFORCED PLASTICS



HIGH PERFORMANCE MOLD STEELS FOR INJECTION OF REINFORCED PLASTICS

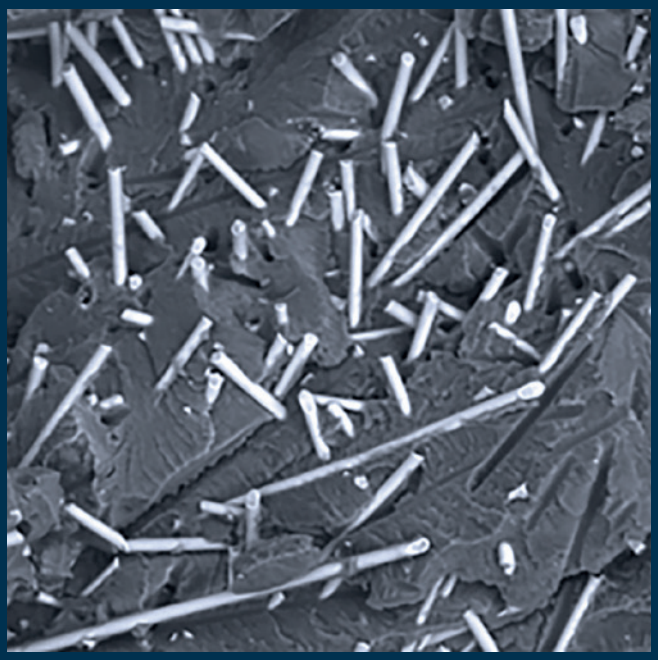
Modern industrial parts production in mainly automotive and electronic industries is characterized by the trend to substitute metals by reinforced plastics. Being much lighter and therefore weight-saving, such plastic components help to reduce CO_2 emissions, which is a clear ecologic focus worldwide. Intricate geometries, thin wall-thicknesses and large areas of the parts are characteristics that call for a growing amount of glass or carbon fibers in the plastics to obtain sufficient stability.

Plastics reinforced by fibers tend to be much more abrasive than conventional plastics and thus may cause premature wear of an injection mold. In order to fight excessive and early wear in molds, BÖHLER Edelstahl is offering a wide variety of high-quality tooling steels that are setting new standards in the production of heavy-duty components made from reinforced plastics.



The product

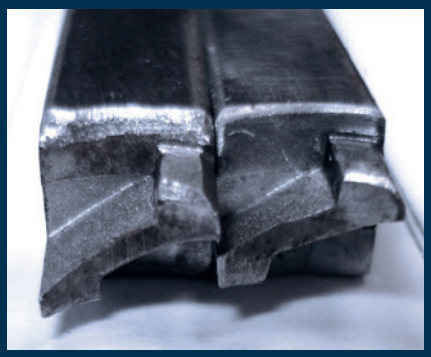
The plastics



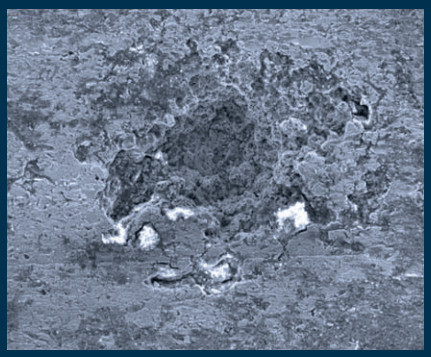
REQUIREMENTS AND TRENDS

- New types of high performance plastics (GF, CF, fibre length, filler material)
- Increasing wear resistance requirements on mold material
- Increasing corrosion resistance of mold material
- Complexity of parts increased (light weight construction)
- Increase productivity through shorter cycle times (thermal conductivity)
- Higher closing pressures and working temperatures

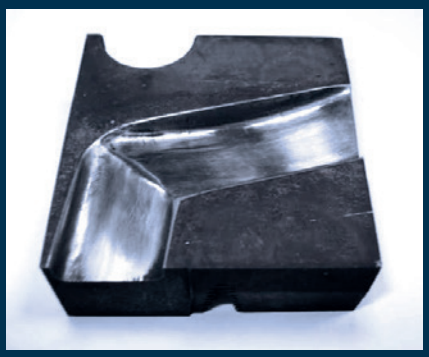
Typical failure modes



Slider in plastic mold
PA66 + 30% GF
Premature fracture due to low material toughness



Core Pin - Microstructure
PBT + 45% GF
Corrosive attack due to insufficient corrosion resistance



Mold Insert
PVC + %20 GF
Massive wear on surface due to lack of wear resistance

BEST APT STEEL GRADES FOR INJECTION OF REINFORCED PLASTICS

Non corrosion resistant steels

BÖHLER grade	Chemical composition (average, %)						Standards		
	C	Cr	Mo	Ni	V	Others	DIN / EN		AISI
BÖHLER K600 ISODUR®	0,45	1,30	0,25	4,00	–	–	< 1.2767 >	X45NiCrMo4	–
BÖHLER W300 ISOBLOC®	0,36	5,00	1,30	–	0,40	Si = 1,10	< 1.2343 >	X38CrMoV5-1	H11
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	–	–
BÖHLER W360 ISOBLOC®	0,50	4,50	3,00	–	0,55	Si = 0,20	Patented		–
BÖHLER K340 ISODUR®	1,10	8,30	2,10	–	0,50	Si = 0,90	Patented		–
BÖHLER K490 MICROCLEAN®	1,40	6,40	1,50	3,70	3,50	+ Nb	Patented		–
BÖHLER K390 MICROCLEAN®	2,50	4,00	4,00	–	9,00	W = 1,00 Co = 2,00	Patented		–

Corrosion resistant steels

BÖHLER grade	Chemical composition (average, %)						Standards	
	C	Cr	Mo	Ni	V	Others	DIN / EN	AISI
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 M333 ISOPLAST®	0,28	13,50	–	–	–	+ N	Patented	~ 420
BÖHLER M340 ISOPLAST®	0,54	17,30	1,10	–	0,10	+ N	Patented	–
BÖHLER M368 MICROCLEAN®	0,54	17,30	1,10	–	0,10	+ N	Patented	–
BÖHLER M390 MICROCLEAN®	1,90	20,00	1,00	–	4,00	W = 0,60	Patented	–

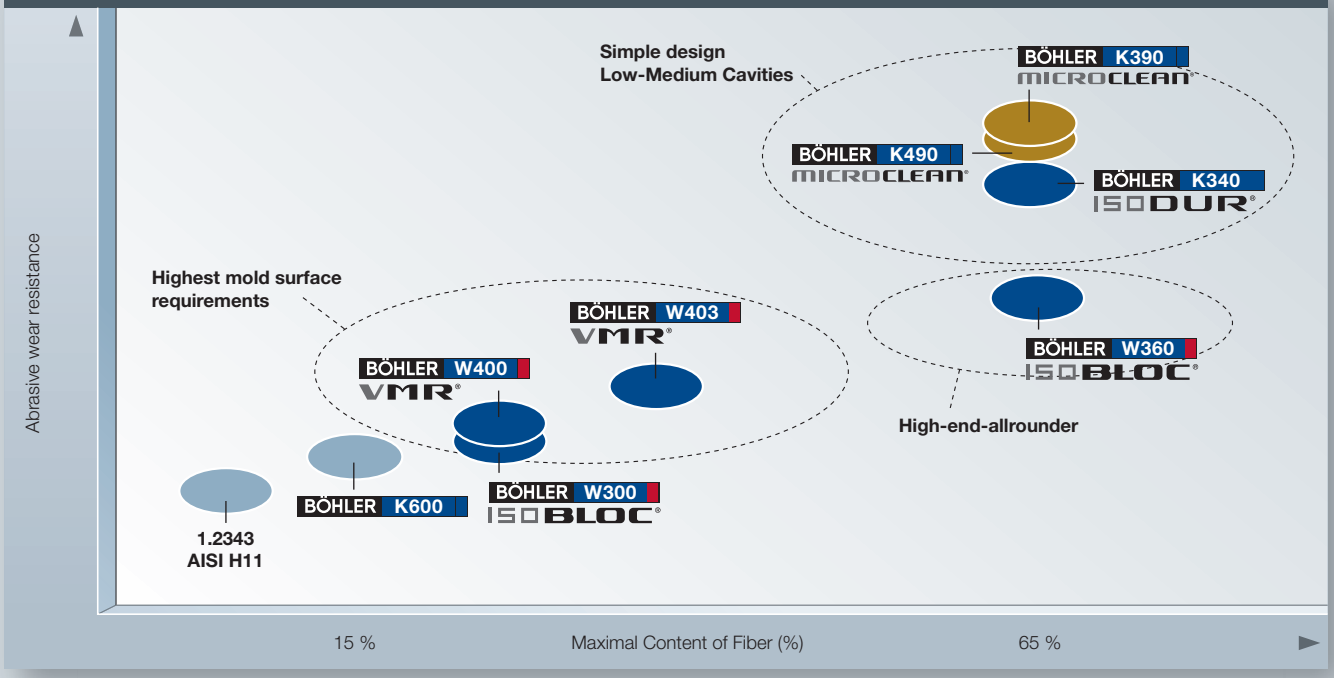
MATERIAL SELECTION CRITERIA FOR MOLD-MAKER AND PARTS MANUFACTURER

Non corrosion resistant steels*

BÖHLER grade	Plastic processed	Content of fiber	Mold hardness	Mold cavity	Mold design	Mold surface requirement
BÖHLER K600 ISODUR®	PP, PE, ABS, PS, PC, PA	0 – 15 %	≤ 50 HRC	★★	★★	★★
BÖHLER W300 ISOBLOC®		0 – 20 %	≤ 50 HRC	★★★★★	★★	★★★
BÖHLER W400 VMR®		0 – 20 %	≤ 52 HRC	★★	★★★★★	★★★★★
BÖHLER W403 VMR®		0 – 30 %	≤ 52 HRC	★★★★	★★★★★	★★★★
BÖHLER W360 ISOBLOC®	All Thermo and Duroplasts products	0 – 65 %	≤ 57 HRC	★★★★	★★★★★	★★★
BÖHLER K340 ISODUR®		0 – 65 %	≤ 62 HRC	★	★	★★
BÖHLER K490 MICROCLEAN®		0 – 65 %	≤ 64 HRC	★★	★★	★★★★
BÖHLER K390 MICROCLEAN®		0 – 65 %	≤ 64 HRC	★	★	★★★★

*) Please note that this table has to be understood as general guideline only. Any deviating individual case has to be discussed separately.

Comparison chart – BOHLER Non Corrosion resistant steels



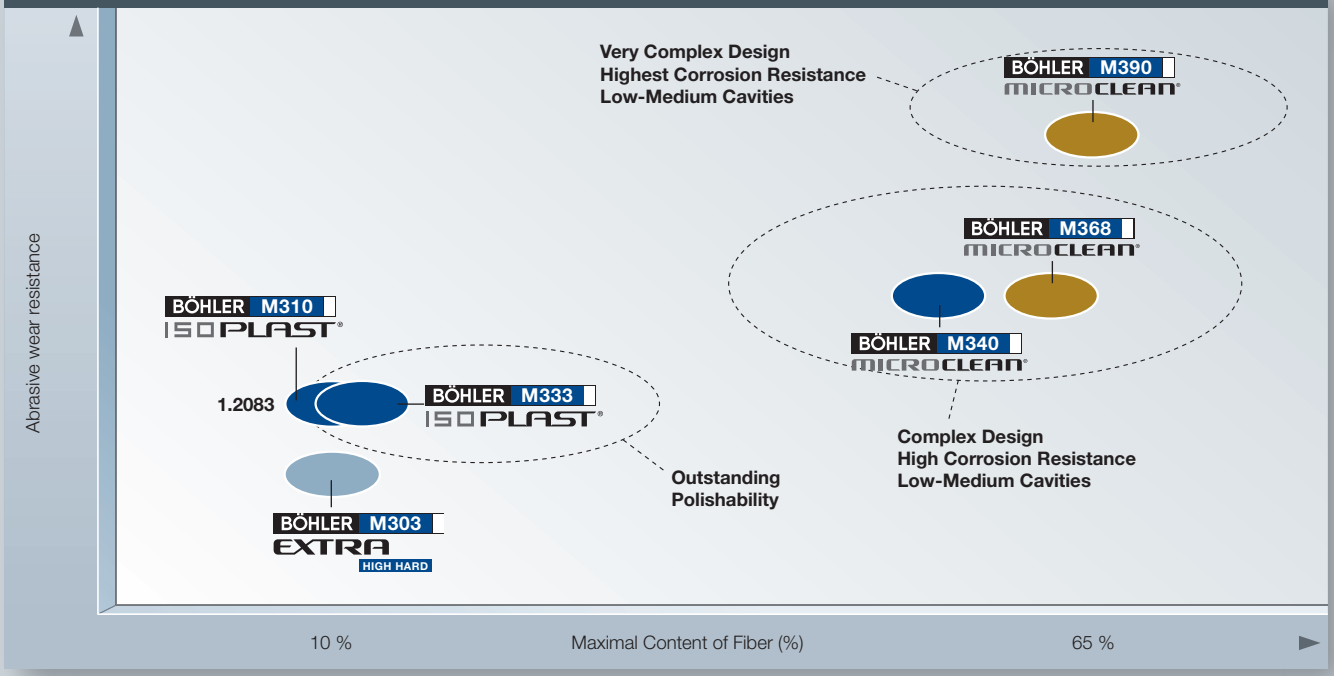
	Mold design	Mold cavity	Mold surface requirement
★★★★★	Very complex	Very deep	Highest
★★★★	Complex	Deep	High
★★★	Medium	Medium	Good
★★	Advanced	Low-Medium	Advanced
★	Simple	Low	Standard

Corrosion resistant steels*

BÖHLER grade	Plastic processed	Content of fiber	Mold hardness	Mold cavity	Mold design	Mold surface requirement
BÖHLER M303 EXTRA HIGH HARD	PP, PE, ABS, PS, PC, PA, PVC, POM	0 – 10 %	≤ 40 HRC	★★★★	★★★★	★★★★
BÖHLER M310 ISOPLAST		0 – 15 %	≤ 50 HRC	★★	★★★	★★
BÖHLER M333 ISOPLAST		0 – 15 %	≤ 50 HRC	★★★	★★★★	★★★★★
BÖHLER M340 ISOPLAST		0 – 55 %	≤ 56 HRC	★★	★	★★
BÖHLER M368 MICROCLEAN		0 – 60 %	≤ 56 HRC	★★	★★★★	★★★★
BÖHLER M390 MICROCLEAN		0 – 65 %	≤ 62 HRC	★★	★★★★★	★★★★

*) Please note that this table has to be understood as general guideline only. Any deviating individual case has to be discussed separately.

Comparison chart – BOHLER Corrosion resistant steels



	Mold design	Mold cavity	Mold surface requirement
★★★★★	Very complex	Very deep	Highest
★★★★	Complex	Deep	High
★★★	Medium	Medium	Good
★★	Advanced	Low-Medium	Advanced
★	Simple	Low	Standard

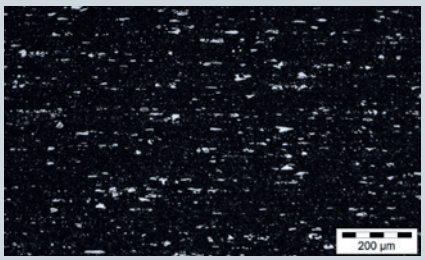
3 QUALITY LEVELS – 3 TECHNOLOGIES

PESR Manufacture

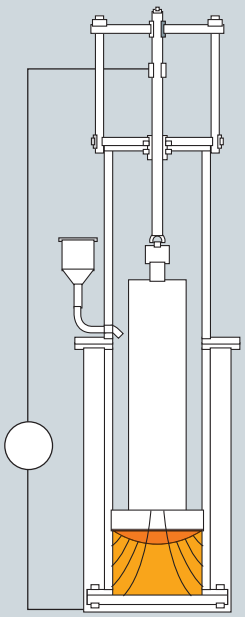
ISODUR®
ISOPLAST®
ISOBLOC®

Improved service life due to:

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



Microstructure of 8% chromium steel in ESR grade

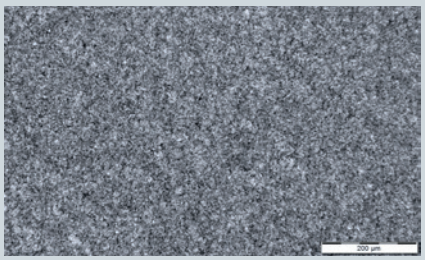


VAR Manufacture

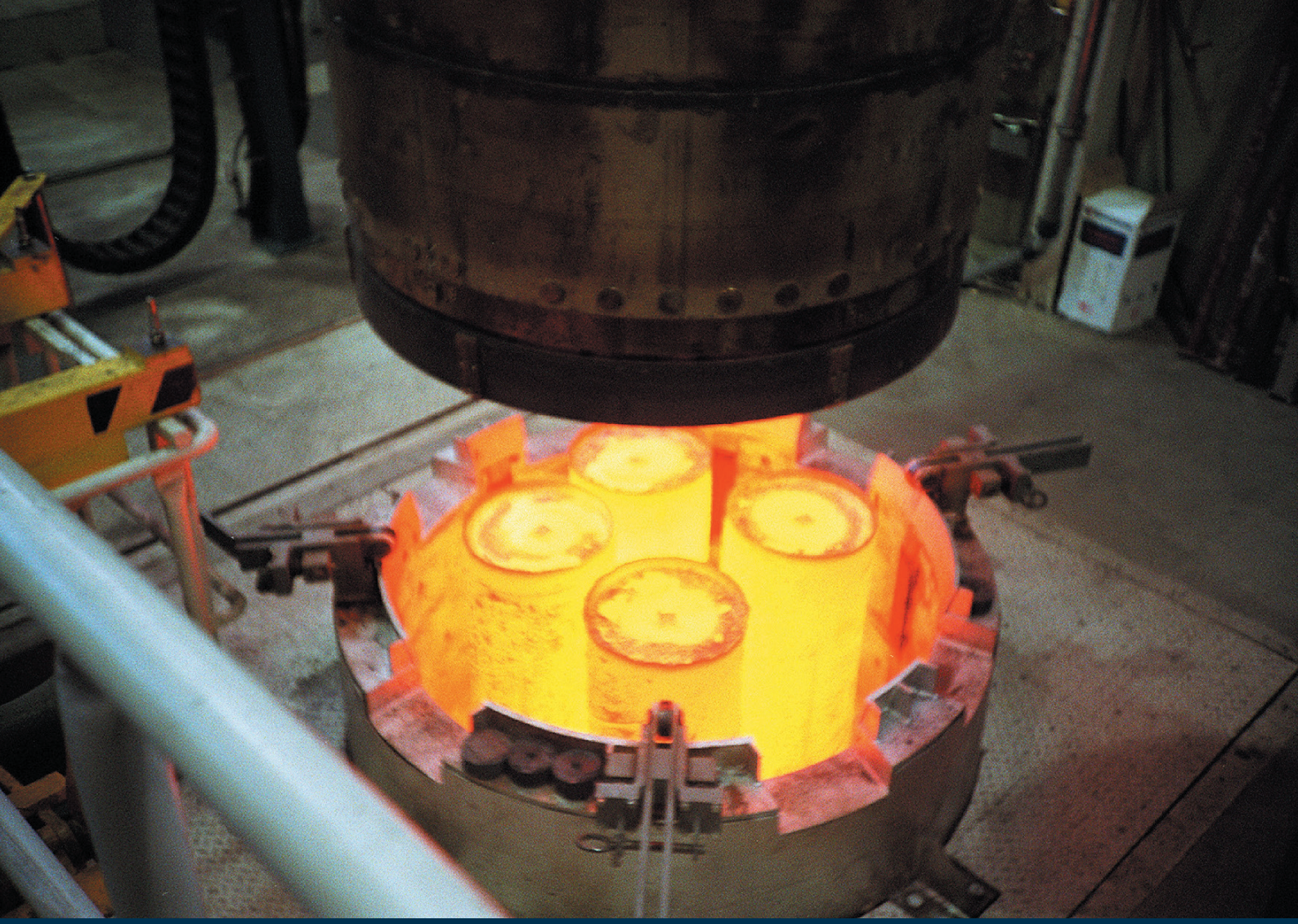
VMR®

Material properties:

- Minimum gas contents
- Reduction of trace elements such as Pb, Bi, Te, As, Sn, Sb
- Minimum microsegregations in the ingot centre
- Low susceptibility to the formation of freckles (segregations)
- Highly precise chemical analysis
- High cleanliness



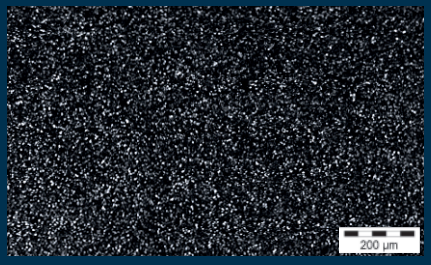
K455 VMR technology



Powder metallurgical production
MICROCLEAN®

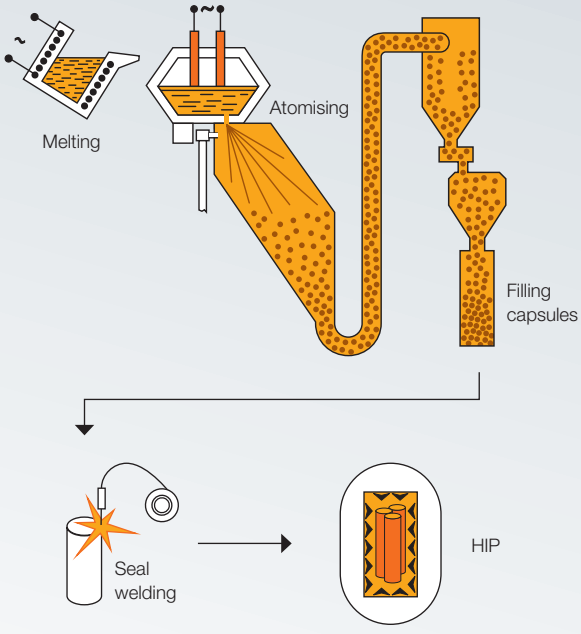
Materials produced using powder metallurgy are increasingly being used to meet the most stringent requirements with various processing methods. These materials offer properties that meet demanding requirements:

- 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

Production routes for BÖHLER MICROCLEAN



BÖHLER

SPECIAL STEEL FOR THE WORLD´S TOP PERFORMERS

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