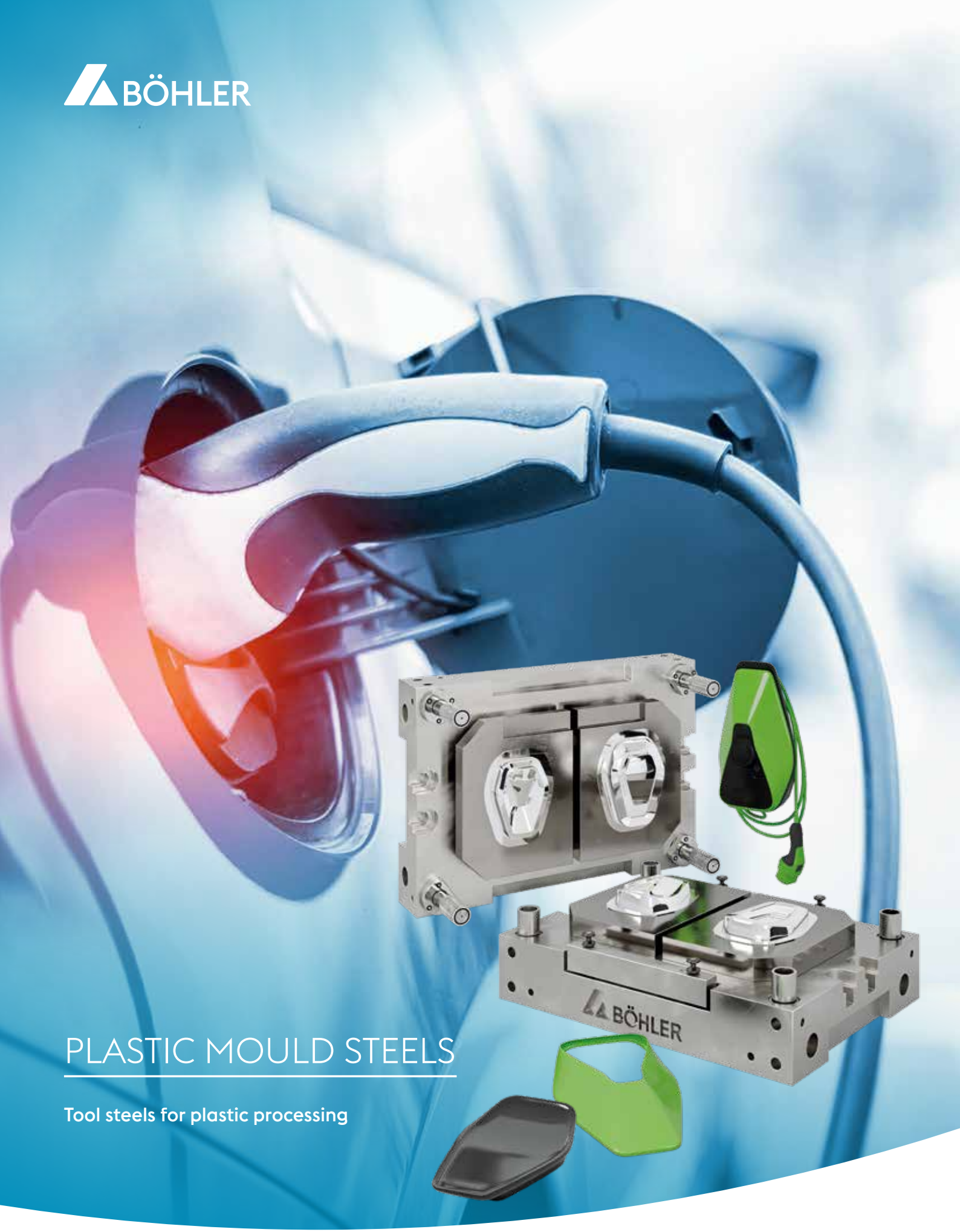
BÖHLER



PLASTIC MOULD STEELS

Tool steels for plastic processing

voestalpine BÖHLER Edelstahl GmbH & Co KG
www.voestalpine.com/bohler-edelstahl

voestalpine
ONE STEP AHEAD.

FORM FOLLOWS FUNCTION

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

MICROCLEAN®
Powder metallurgical high performance steels

ISOPLAST®
Plastic mould steels in ESR quality

VMR®
Tool steels subjected to vacuum melting or refining 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 requirements a product should fulfill. voestalpine BÖHLER Edelstahl therefore provides you with recommendations according to the steel and its properties for best fullfillments of your requirements. voestalpine BÖHLER Edelstahl guarantee consistent quality delivered to plastic processing industry and exhibit a variety of production technologies and tailor-made grades to meet your demands.

Toolmakers requirements	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 etchability	Homogenous materials properties
Individual materials development	Extensive metallurgical knowledge, consultancy services

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

BÖHLER

YOU AS A PLASTIC PROCESSOR
RELY ON HIGHEST TOOL SERVICE LIFE
TO BE ABLE TO PRODUCE CONSISTENTLY
HIGH QUALITY AT HIGH PROCESS SECURITY.

MANUFACTURERS REQUIRE HIGHEST QUALITY

BÖHLER Plastic Mould Steels stand out with variability in properties such as excellent thermal conductivity, corrosion resistance, highest wear resistance, optimum dimensional stability, hardness, toughness and compressive strength. If required, we also offer combinations of these properties including a good repair weldability, low maintenance and servicing and consistent quality, resulting in the highest possible profitability.

Our outstanding experience, innovative research and development and our intense co-operation with plastic processors enable us to provide you with exactly the steel which meets your chemical and mechanical requirements best.

Plastic processors requirements	Material properties
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 material properties and takes into account the different situations in which the tools are used.

BÖHLER grade	Chemical composition in %						Standards		
	C	Cr	Mo	Ni	V	Others	DIN / EN		AISI
CORROSION RESISTANT STEELS									
BÖHLER M303 [1]	0.27	14.50	1.00	0.85	–	+ N	~ 1.2316	X36CrMo17	–
BÖHLER M303 HIGH HARD [1]	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	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	–	–	–
BÖHLER M380 ISOPLAST®	0.30	15.00	1.00	–	–	0.40	< 1.4108 >	X30CrMoN15-1	–
POWDER METALLURGICAL 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	–	–	–
BÖHLER M398 MICROCLEAN®	2.70	20.00	1.00	–	7.20	W = 0.70	–	–	–
PREHARDENED AND PRECIPITATION HARDENED 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	0.13	0.35	–	3.50	–	Mn = 2.00 S = 0.15 Cu = 1.20 Al = 1.20	–	–	–
BÖHLER M461	0.13	0.35	–	3.50	–	Mn = 2.00 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	–

[1] also available in ISOPLAST quality
[2] also available in ISODISC quality
[3] also available in conventional, VMR and ESR quality

OTHER COMMONLY USED STEELS

BÖHLER grade	Chemical composition in %						Standards		
	C	Cr	Mo	Ni	V	Others	DIN / EN		AISI
CORROSION RESISTANT STEELS									
BÖHLER N685	0.90	17.50	1.10	–	0.10	–	< 1.4112 >	X90CrMoV18	~ 440B
BÖHLER N695	1.05	16.70	0.50	–	–	–	< 1.4125 >	X105CrMo15	~ 440C
BÖHLER N690	1.08	17.30	1.10	–	0.10	Co = 1.50	< 1.4528 >	X105CrMo18-2	–
BÖHLER N700 [3]	0.04	15.40	–	4.40	–	Cu = 3.30 Nb = 0.30	< 1.4542 >	X5CrNiCuNb16-4	630
POWDER METALLURGICAL STEELS									
BÖHLER K490 MICROCLEAN®	1.40	6.40	1.50	–	3.70	W = 3.50 +Nb	–	–	–
BÖHLER K390 MICROCLEAN®	2.50	4.00	4.00	–	9.00	W = 1.00 Co = 2.00	–	–	–
HOT AND COLD WORK TOOL STEELS									
BÖHLER K110	1.55	11.80	0.80	–	0.95	–	< 1.2379 >	X155CrVMo12-1	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	0.45	1.30	0.25	4.00	–	–	< 1.2767 >	X45NiCrMo4	–
BÖHLER W300 ISOBLOC® [2]	0.36	5.00	1.30	–	0.40	Si = 1.10	< 1.2343 >	X38CrMoV5-1	H11
BÖHLER W302 ISOBLOC® [2]	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	–	–
BÖHLER W722 VMR®	< 0.03	–	4.90	18.00	–	Co = 9.30 Ti = 1.10	< 1.2709 >	–	–
POWDER FOR ADDITIVE MANUFACTURING									
BÖHLER M789 AMPO	< 0.02	12.20	1.00	10.00	–	Ti = 1.00 Al = 0.60	–	–	–
BÖHLER W722 AMPO	< 0.03	–	4.90	18.00	–	Co = 9.30 Ti = 1.10	< 1.2709 >	–	–
BÖHLER W360 AMPO	0.50	4.50	3.00	–	0.55	–	–	–	–

CORROSION RESISTANT STEELS

Processing of plastics, which contain chemically aggressive or abrasive fillers demand hardenable, corrosion-resistant steels. This reduces mould maintenance significantely in comparison to steels which are less corrosion resistant.

This group of steels is divided into two types: hardenable steels and prehardened steels.

HARDENABLE STEELS

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

PREHARDENED STEELS

Steels which are supplied and used in the prehardened condition. The hardness of approx. 30 – 40 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*)	Wear resistance	Toughness	Polishability**)	Machinability in as-supplied condition	Supplied condition
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 M380 ISOPLAST®	★★★★	★★★	★★★★	★★★★½	★★★★	W max. 255 HB
BÖHLER M398 MICROCLEAN®	★★	★★★★★★	★★	★★	★	W max. 330 HB
BÖHLER N685	★	★★★	★	★	★★	W max. 265 HB
BÖHLER N690	★	★★★★	★	★	★	W max. 285 HB
BÖHLER N695	★	★★★★	★	★	★	W max. 285 HB
PREHARDENED, CORROSION RESISTANT STEELS						
BÖHLER M303	★★★★	★★★	★★★★	★★★★	★★★	V ca. 1000 MPa
BÖHLER M303 ISOPLAST®	★★★★	★★★	★★★★★	★★★★★	★★★	V ca. 1000 MPa
BÖHLER M303 HIGH HARD	★★★	★★★★	★★★	★★★★★	★★	V ca. 40 HRc
BÖHLER M303 ISOPLAST® HIGH HARD	★★★	★★★★	★★★★	★★★★★	★★	V ca. 40 HRc
BÖHLER M314	★★	★★	★★	★½	★★★★	V ca. 1000 MPa
BÖHLER M315	★★	★★	★★	★	★★★★★	V ca. 1000 MPa

Profiles given are characteristic of each group of steels.

*) High tempered, weight loss test with 20 % boiling acetic acid, 24h
**) Rating evaluated together with polishing expert JOKE Technologies
W Soft annealed
V Hardened and tempered to obtain good mechanical properties

POWDER METALLURGICAL STEELS

Powder metallurgical steels are used when extremely long tool lifes are required and therefore wear resistance and hardness are important. These materials are primarily used for extruder screws and back-flow valves, but also for processing of fibre-reinforced plastics. Corrosion resistant variants are available with the grades BÖHLER M368, M398 and M390 MICROCLEAN.

PARTICULAR ADVANTAGES ARE:

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

BÖHLER grade	Corrosion resistance*)	Wear resistance	Toughness	Polishability**)	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
BÖHLER K490 MICROCLEAN	not applicable	★★★	★★★★	★★★★	★★	W max. 280 HB
BÖHLER M398 MICROCLEAN	★★	★★★★★	★★	★★★	★★	W max. 330 HB

The profiles given are characteristic of each group of steels.

*) High tempered, weight loss test with 20 % boiling acetic acid, 24h
**) Rating evaluated together with polishing expert JOKE Technologies
W Soft annealed
V Hardened and tempered to obtain good mechanical properties
LA Solution annealed and precipitation hardened

PREHARDENED STEELS

The development of ever-larger plastic parts increases complexity of heat treatments of the moulds. In order to eliminate dimensional changes and quench cracking, prehardened steels are used for large tools.
They are heat-treated to a hardness of 290 – 400 HB / approx. 30 – 40 HRc by BÖHLER. At this hardness, steel retains its good machinability but still has good wear resistance and adequate strength.

PARTICULAR ADVANTAGES OF PREHARDENED STEELS ARE:

» No need of heat treatment after machining

» Can be used as delivered, even in large dimensions

BÖHLER grade	Wear resistance	Toughness	Polishability*)	Machinability in as-supplied condition	Through-hardenable	Etchability	Supplied condition
BÖHLER M200	★★	★★	★★	★★★★★	★	★★	V ca. 1000 MPa
BÖHLER M238	★★	★★★★	★★★	★★★	★★★★	★★★	V ca. 1000 MPa
BÖHLER M238 HIGH HARD	★★★★	★★★	★★★★	★★	★★★★	★★★★	V ca. 40 HRc
BÖHLER M268 VMR®	★★★★	★★★★★	★★★★★	★★	★★★★	★★★★★	V ca. 40 HRc
BÖHLER M261	★★★	★★	★★½	★★★★	★★★	★★	LA ca. 40 HRc
BÖHLER M461	★★★	★★★	★★★	★★★	★★★	★★★	LA ca. 40 HRc

HOT AND COLD WORK TOOL STEELS

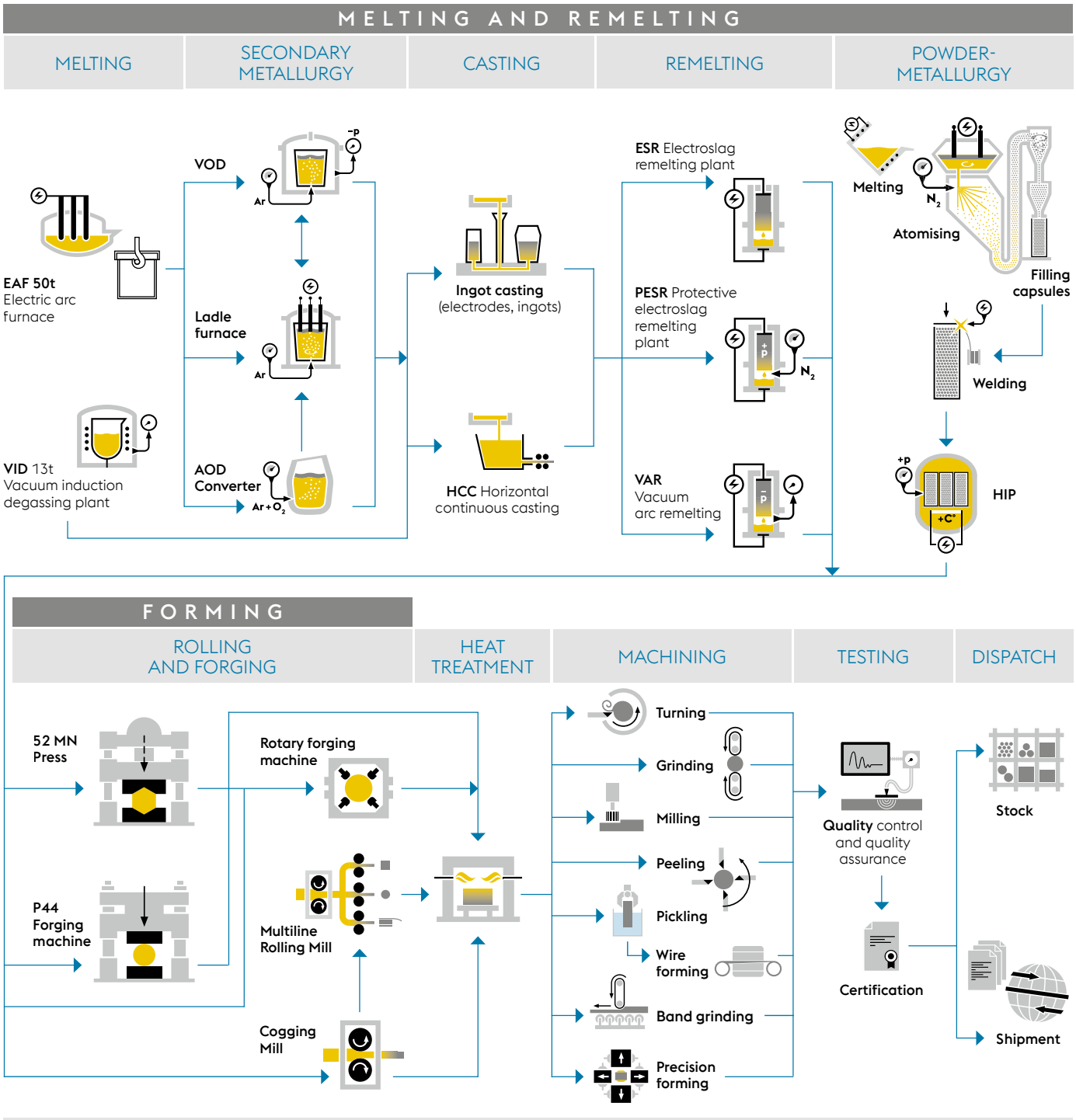
Due to specific properties and combinations of properties these steels can be used as an alternative to, or in addition to, other steels where corrosion resistance is not required.

BÖHLER grade	Wear resistance	Toughness	Polishability**)	Machinability in as-supplied condition	Supplied condition
COLD WORK TOOL 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
BÖHLER K490 MICROCLEAN®	★★★★	★★	★★★★	★★	W max. 280 HB
HOT WORK TOOL STEELS					
BÖHLER W300 ISOBLOC®	★	★★★★	★★★	★★★★★	W max. 205 HB
BÖHLER W302 ISOBLOC®	★★	★★★★	★★	★★★★★	W max. 205 HB
BÖHLER W350 ISOBLOC®	★★	★★★★	★★★½	★★★★★	W max. 205 HB
BÖHLER W360 ISOBLOC®	★★	★★★★	★★★½	★★★★	W max. 205 HB
BÖHLER W400 VMR®	★	★★★★★	★★★★★	★★★★	W max. 205 HB
BÖHLER W403 VMR®	★★	★★★★	★★★★½	★★★★	W max. 205 HB
BÖHLER W722 VMR®	★★	★★★★★	★★★★★	★★	L max. 353 HB

The profiles given are characteristic of each group of steels.

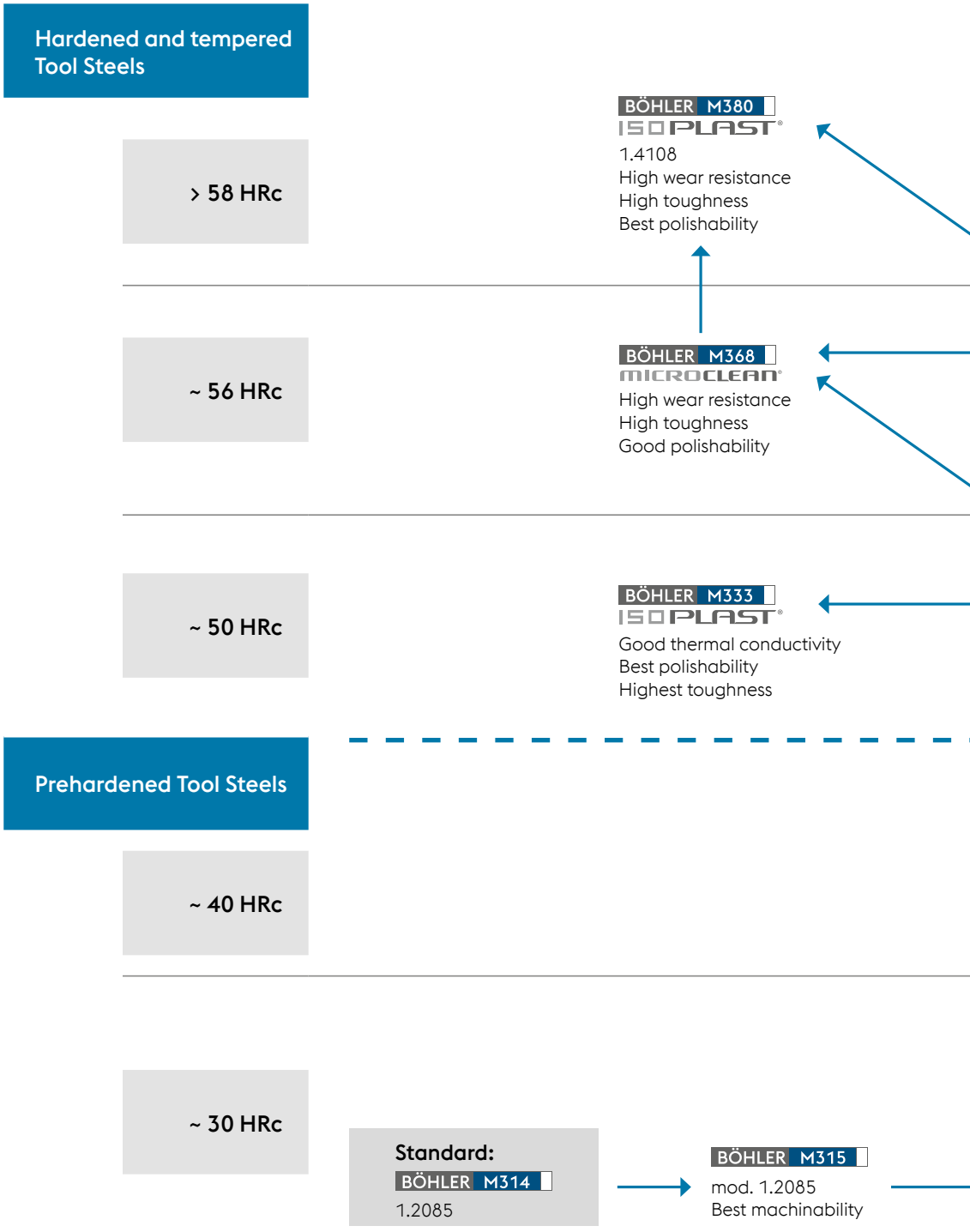
**) Rating evaluated together with polishing expert JOKE Technologies
W Soft annealed
L Solution annealed

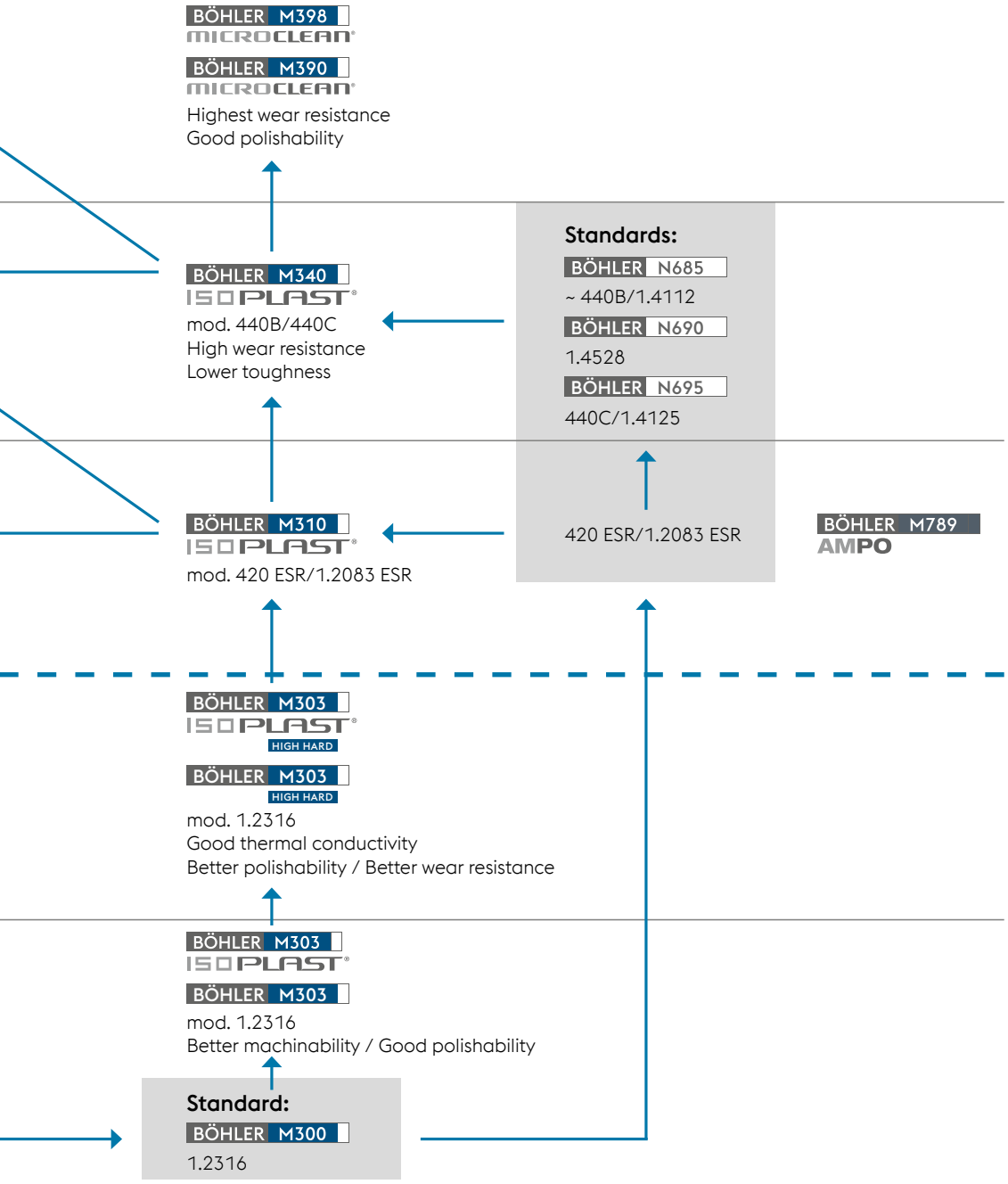
FLOW OF MATERIAL



DECISION TREE
CORROSION RESISTANT

plastic mould steel grades





MICROCLEAN®
Powder metallurgical steels

ISOPLAST®
Plastic mould steels in ESR quality

AMPO
Powder for additive manufacturing

DECISION TREE
NON CORROSION RESISTANT

plastic mould and tool steel grades

Hardened and tempered Tool Steels

> 58 HRc

BÖHLER K490 MICROCLEAN®
Universal PM
Very good hard machinability

~ 56 HRc

BÖHLER W722 VMR®
1.2709
Highest fatigue resistance
Good dimensional stability
(Precipitation hardened)

~ 50 HRc

BÖHLER W400 VMR®
~ H11
Higher toughness
Better polishability

BÖHLER W403 VMR®
Better polishability

Prehardened Tool Steels

~ 40 HRc

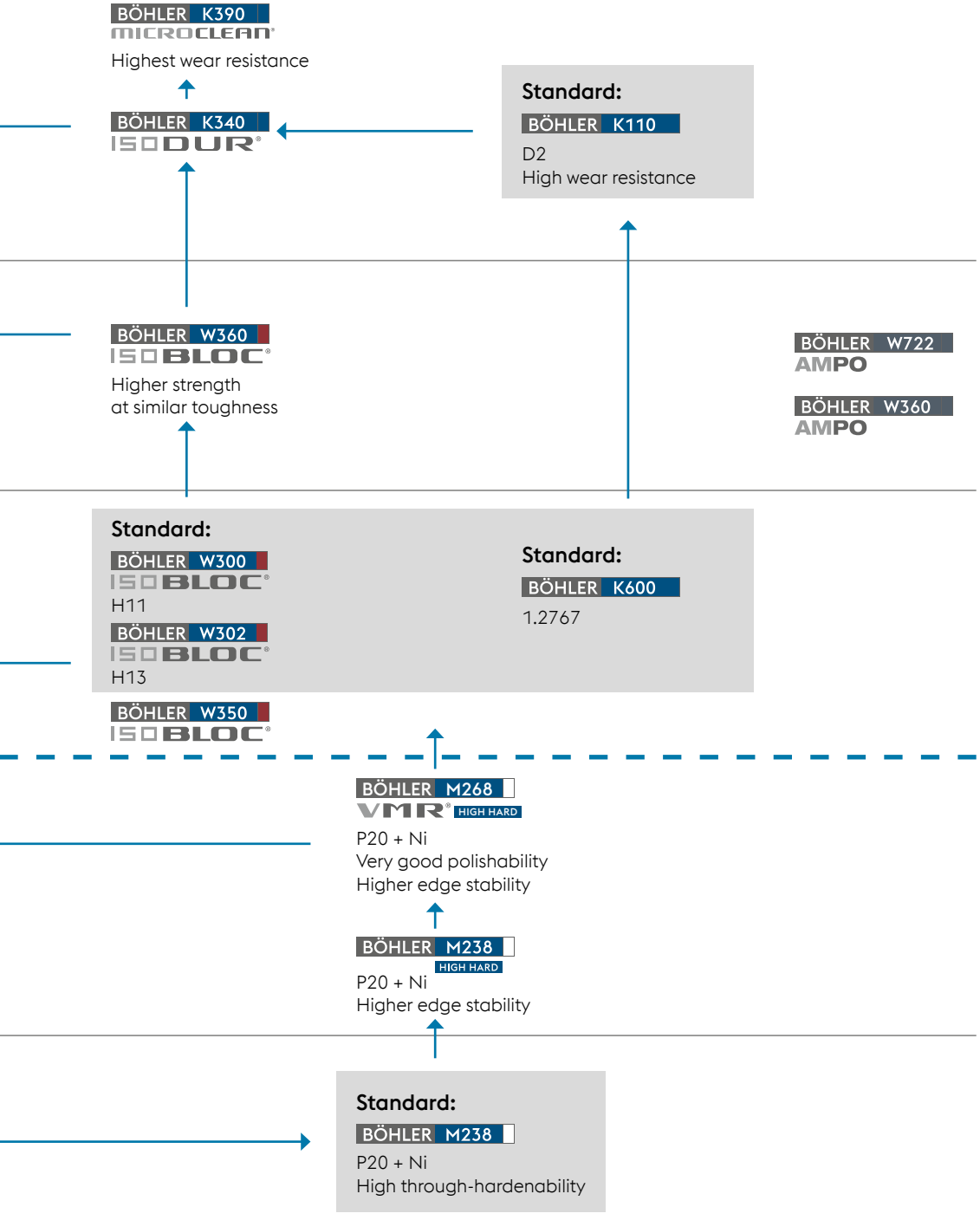
BÖHLER M261
Good machinability
Good dimensional stability
(Precipitation hardened)

~ 30 HRc

Standards:
1.1730 (Ck 45N)

BÖHLER M201
~ P20

BÖHLER M200
P20
Good polishability
Good machinability



MICROCLEAN®
Powder metallurgical steels

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

ISODUR®
Cold work tool steels in ESR quality

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

AMPO
Powder for additive manufacturing

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voestalpine
ONE STEP AHEAD.