
# HIGH PERFORMANCE METALS FOR RACING APPLICATIONS

# SPECIAL MATERIALS FOR WINNERS

## FASTER, LIGHTER, STRONGER –

terms of our time which must be taken literally, especially in the racing industry. Fulfilling these requirements demands everything of materials. BÖHLER provides the materials that racing engineers need – in the grade and dimension they want.

Each and every step of production – from melting to delivery – is in our own hands and means the highest, most consistent quality for you. This is why BÖHLER is one of the most reliable partners for the racing industry.

**No limits, high performance materials for**

» Formula 1
» Indycar Series
» DTM
» CART
» Rally Cars
» Motor Cycles

**Applications**

» Gears
» Crankshafts
» Driveshafts
» Bearings
» Conrods
» Camshafts
» Differentials

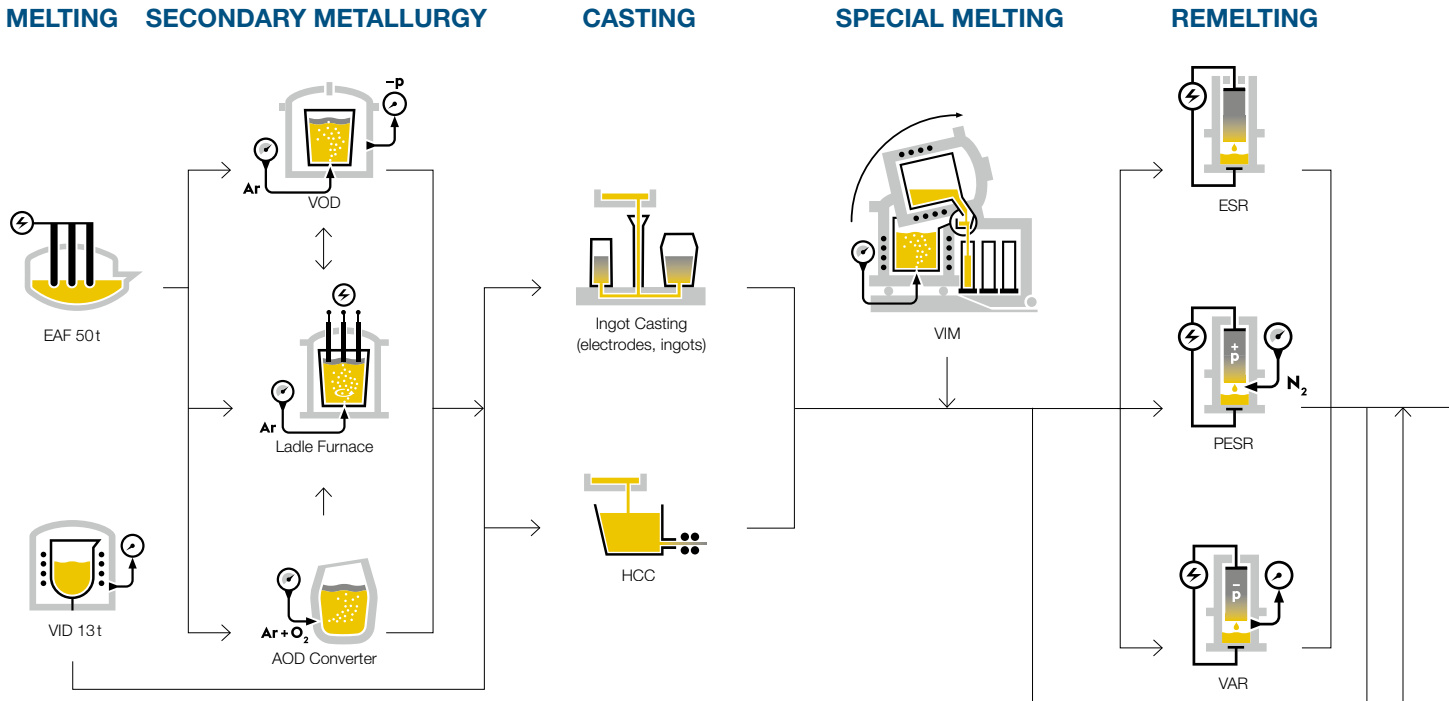
## BÖHLER UNLIMITED

With the UNLIMITED series BÖHLER offers optimised as well as newly developed material solutions designed for demanding Racing applications. One example would be our BÖHLER W460 UNLIMITED which is optimised to an outstanding fatigue strength and balanced mechanical properties.

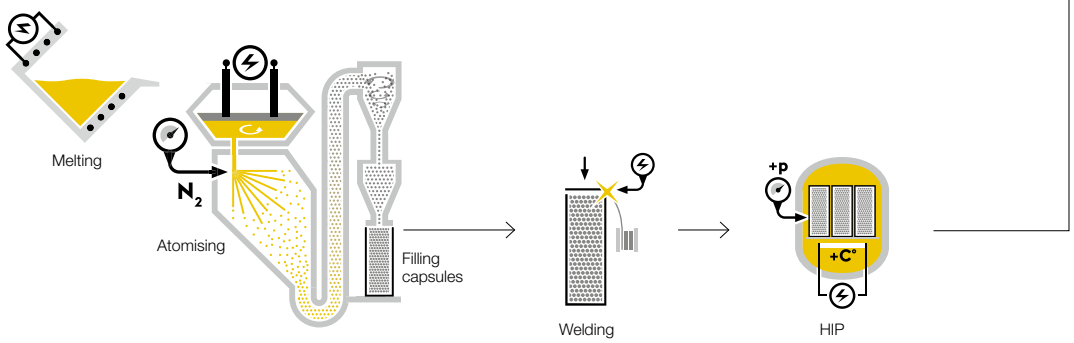
Find out more details about our UNLIMITED portfolio within this brochure (Page 6) or contact one of our material experts.

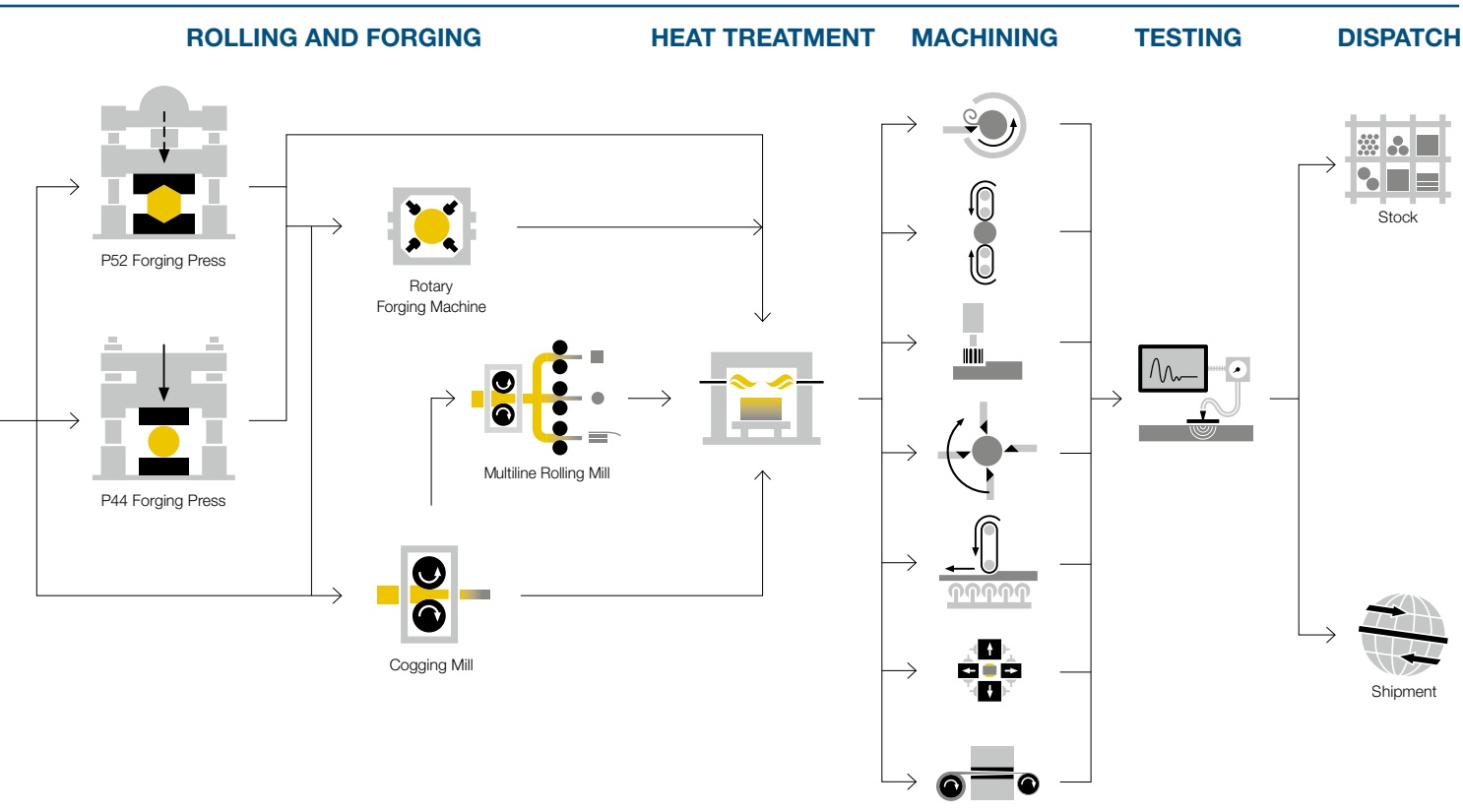
# TRENDSETTING TECHNOLOGIES FOR HIGHEST METALLURGICAL PERFORMANCE

## FLOW OF MATERIAL

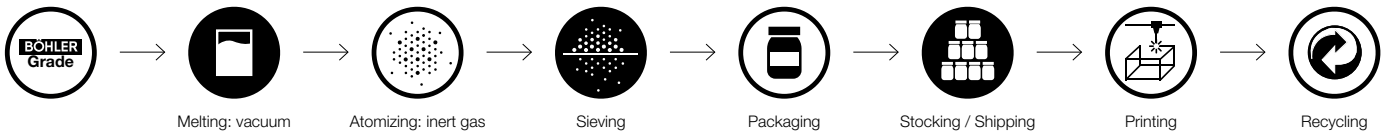



## POWDER METALLURGY




ROLLING AND FORGING
HEAT TREATMENT
MACHINING
TESTING
DISPATCH
P52 Forging Press
P44 Forging Press
Rotary
Forging Machine
Multiline Rolling Mill
Cogging Mill
Stock
Shipment

## AMPO


BÖHLER Grade
Melting: vacuum
Atomizing: inert gas
Sieving
Packaging
Stocking / Shipping
Printing
Recycling

# THE QUALITY OF YOUR COMPONENTS STARTS HERE

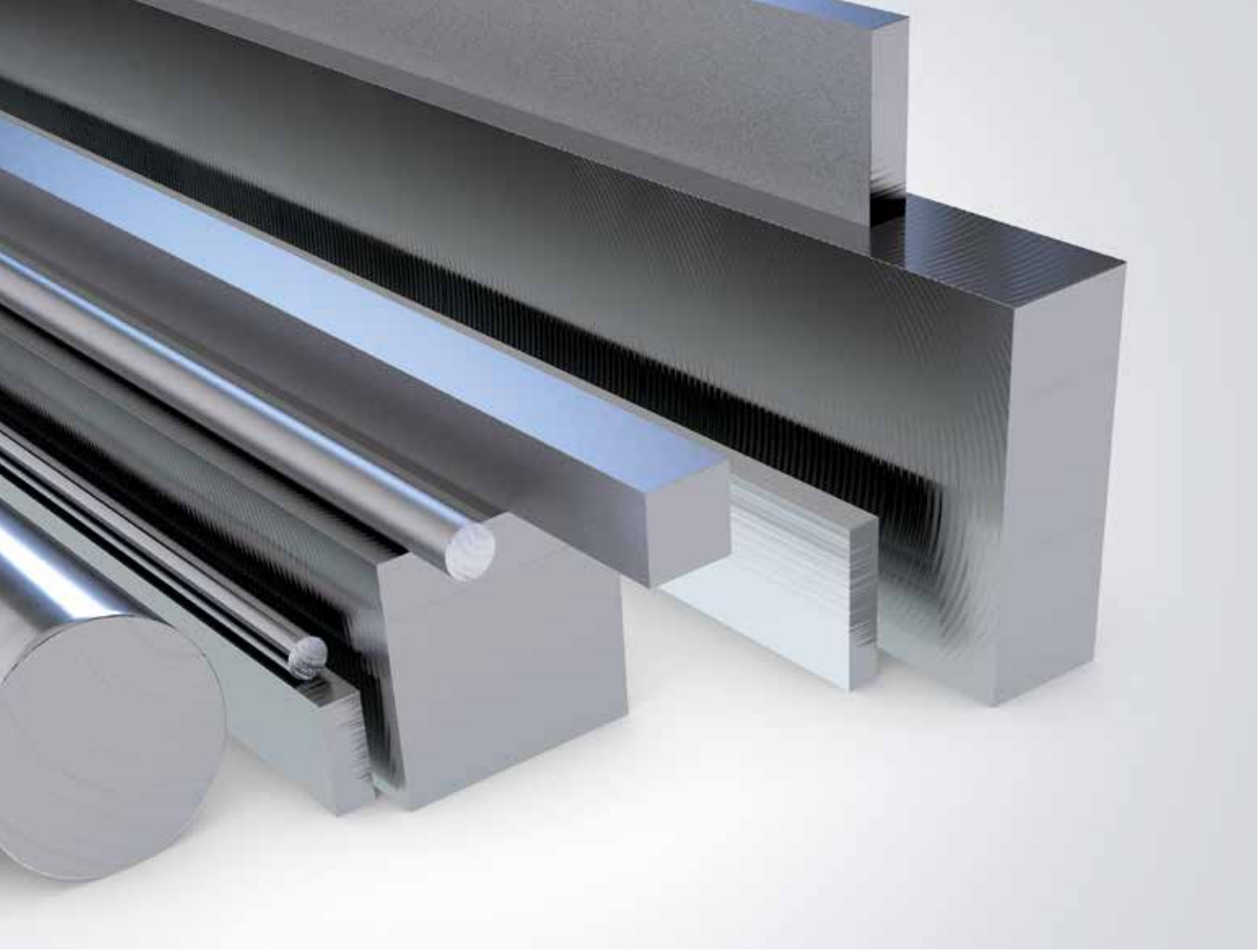
A wide variety of possibilities when it comes to the machining and finishing of long products allows us to dedicate ourselves to customer requirements individually and rapidly in the BÖHLER service tradition.

Rolled bar steel is put through a heat treatment and machined, finished and tested according to customer specifications.

BÖHLER endeavours to fulfil every customer request regarding surface treatment: bar steel, round-peeled, peeled and polished, continuously ground or turned; machined at both ends upon request; bar steel, flat milled and cut to large-scale flat dimensions. In the BÖHLER tolerance range you require.

**For example:**

| | |
|---|---|
| IBO ECOMAX | bar steel, peeled |
| ECOBLANK | bright steel, peeled and polished, decarb-free |
| ECOFINISH | bright steel, band ground |
| BRIGHT STEEL | ground and polished |



**BARS rolled**

round: 12.5 – 150 mm
square: 15 – 150 mm

| flat: | width | thickness |
|---|---|---|
| | 15 – 60 mm | 5 – 41 mm |
| | 60 – 200 mm | 5 – 86 mm |
| | 100 – 300 mm | 15 – 80 mm |

**ROLLED WIRE**

rolled: dia. 5.0 – 13.5 mm
drawn: dia. 1.0 – 12.0 mm
precision shaped:
round 1 – 28 mm
flat 0.5 – 40 $mm^2$

**BARS forged**

round, square: 100 – 1200 mm

| flat: | width | thickness |
|---|---|---|
| | 1600 | 1000 mm maximum |

Ratio width/thickness maximum 10:1

**BARS pre-machined**

IBO ECOMAX12.5 – 425 mm
(on request up to 900 mm)

# A WIDE RANGE OF GRADES

| BÖHLER grade | Market grade | Melting route | AMS | BS | Others | Chemical composition in % | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | C | Si | Mn | Cr | Mo | Ni | V | W | Co | Ti | Al | Others |
| **HEAT TREATABLE STEELS** | | | | | | | | | | | | | | | | | |
| BÖHLER V124SC | 4340 | (P)ESR-VMR | 6414 | – | 1.6944<br>~ 40NiCrMo6 | 0.42 | 0.30 | 0.80 | 0.85 | 0.30 | 1.90 | 0.08 | – | – | – | 0.03 | – |
| BÖHLER V132 | 300M | VMR | 6257<br>6419 | S155 | SAE 4340M | 0.42 | 1.65 | 0.80 | 0.80 | 0.40 | 1.80 | 0.08 | – | – | – | – | – |
| BÖHLER V145 | 30CDN8 | Airmelted | – | – | 1.6604<br>30CrNiMo8 | 0.30 | 0.30 | 0.50 | 2.00 | 0.35 | 2.00 | – | – | – | – | – | – |
| BÖHLER V180<br>UNLIMITED | – | VMR | – | – | – | 0.41 | 2.70 | 0.70 | 0.85 | 0.45 | 1.80 | 0.21 | – | – | – | – | – |
| BÖHLER V358 | E40CDV12 | (P)ESR-VMR | – | S132 | 1.8523 | 0.41 | 0.28 | 0.65 | 3.35 | 0.95 | – | 0.20 | – | – | – | – | – |
| BÖHLER V361 | E32CDV13 | (P)ESR-VMR | 6481 | – | 1.7765 | 0.33 | 0.28 | 0.50 | 3.00 | 1.00 | – | 0.25 | – | – | 0.033 | – | – |
| BÖHLER M201 | – | Airmelted | – | – | 1.2311 | 0.41 | 0.30 | 1.50 | 2.00 | 0.20 | – | – | – | – | – | – | – |
| BÖHLER M238 | – | Airmelted | – | – | 1.2738 | 0.38 | 0.30 | 1.50 | 2.00 | 0.20 | 1.10 | – | – | – | – | – | – |
| BÖHLER M268 | – | VMR | – | – | 1.2738 | 0.38 | 0.30 | 1.50 | – | – | – | – | – | – | – | – | – |
| BÖHLER W360 | – | (P)ESR | – | – | – | 0.50 | 0.20 | 0.25 | 4.50 | 3.00 | – | 0.60 | – | – | – | – | – |
| BÖHLER W460<br>UNLIMITED | – | VMR | – | – | – | 0.50 | 0.20 | 0.45 | 4.55 | 3.00 | – | 0.75 | – | – | – | – | – |
| BÖHLER W400 | – | VMR | ~ H11 | ~ BH11 | – | 0.37 | 0.20 | 0.30 | 5.00 | 1.30 | – | 0.50 | – | – | – | – | – |
| BÖHLER K600 | – | Airmelted | – | – | 1.2767 | 0.48 | 0.25 | 0.40 | 1.30 | 0.25 | 4.00 | – | – | – | – | – | – |
| **CASE CARBURISING STEELS** | | | | | | | | | | | | | | | | | |
| BÖHLER E108 | – | Airmelted-<br>(P)ESR-VMR | – | S156 | 1.6722 | 0.17 | 0.28 | 0.80 | 0.70 | 0.25 | 4.10 | – | – | – | – | – | – |
| BÖHLER M100 | – | Airmelted | – | – | 20MnCr5 | 0.20 | 0.28 | 1.20 | 1.10 | – | – | – | – | – | – | – | – |
| BÖHLER M121 | – | (P)ESR | – | – | EN36C | 0.14 | 0.28 | 0.55 | 0.90 | 0.13 | 3.15 | – | – | – | – | – | – |
| BÖHLER M130 | – | Airmelted | – | – | EN39 | 0.19 | 0.23 | 0.30 | 1.25 | 0.20 | 4.05 | – | – | – | – | – | – |
| **PH GRADES (STAINLESS STEELS)** | | | | | | | | | | | | | | | | | |
| BÖHLER N700 | 17-4 PH | Airmelted-<br>(P)ESR-VMR | 5643<br>5622 | – | 1.4542<br>1.4548 | 0.04 | 0.25 | 0.40 | 15.28 | – | 4.50 | – | – | – | – | – | Cu: 3.25<br>Nb: 0.30 |
| BÖHLER N701 | 15-5 PH | Airmelted-<br>(P)ESR | 5659 | – | 1.4545 | 0.035 | 0.28 | 0.60 | 14.88 | – | 5.15 | – | – | – | – | – | Cu: 3.30<br>Nb: 0.30 |
| BÖHLER N709 | 13-8 Mo | VMR | 5629 | – | 1.4534 | 0.03 | – | – | 12.45 | 2.18 | 8.15 | – | – | – | – | 1.06 | – |

| BÖHLER grade | Market grade | Melting route | AMS | BS | Others | Chemical composition in % | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | C | Si | Mn | Cr | Mo | Ni | V | W | Co | Ti | Al | Others |
| **BEARING STEELS** | | | | | | | | | | | | | | | | | |
| BÖHLER N360 | X30 | (P)ESR | 5898 | – | 1.4108<br>X30CrMoN15-1 | 0.32 | 0.55 | 0.45 | 15.00 | 1.03 | – | 0.045 | – | – | – | – | – |
| BÖHLER N695 | 440C | Airmelted-VMR | 5618<br>5630 | – | 1.3544<br>X105CrMo17<br>S102CrMo17 | 1.05 | 0.40 | 0.40 | 16.70 | 0.50 | – | – | – | – | – | – | – |
| BÖHLER R250 | M50 | VMR | 6491 | – | ~ 1.3551 | 0.83 | 0.18 | 0.28 | 4.13 | 4.30 | – | 1.05 | – | – | – | – | – |
| BÖHLER R350 | M50 Nil | VMR | 6278 | – | – | 0.14 | 0.18 | 0.28 | 4.15 | 4.25 | 3.50 | 1.23 | – | – | – | – | – |
| BÖHLER V124SC | 4340 | (P)ESR-VMR | 6414 | – | 1.6944<br>~ 40NiCrMo6<br>EN24 VAR | 0.42 | 0.30 | 0.80 | 0.85 | 0.30 | 1.90 | 0.08 | – | – | – | 0.03 | – |
| **MARAGING STEELS** | | | | | | | | | | | | | | | | | |
| BÖHLER V720 | Maraging 300 | VMR | 6514 | – | 1.6354 | ≤ 0.005 | ≤0.05 | ≤0.05 | – | 5.00 | 18.50 | – | – | 8.80 | 0.70 | 0.10 | – |
| BÖHLER V723 | Maraging 250 | VMR | 6512 | S162 | 1.6359 | – | – | – | – | 4.90 | – | – | – | 7.80 | 0.40 | 0.13 | – |
| **PM PRODUCTION** | | | | | | | | | | | | | | | | | |
| BÖHLER K490 MICROCLEAN | – | – | – | – | – | 1.40 | – | – | 6.40 | 1.50 | – | 3.70 | 3.50 | – | – | – | + Nb |
| BÖHLER M390 MICROCLEAN | – | – | – | – | – | 1.91 | 0.60 | 0.30 | 20.0 | 1.00 | – | 4.00 | 0.60 | – | – | – | N: 0.24 |
| BÖHLER S290 MICROCLEAN | – | – | – | – | – | 2.00 | – | – | 3.80 | 2.50 | – | 5.10 | 14.30 | 11.00 | – | – | – |
| BÖHLER S390 MICROCLEAN | – | – | – | – | – | 1.64 | – | – | 3.80 | 2.00 | – | 4.80 | 10.40 | 8.00 | – | – | – |
| BÖHLER S590 MICROCLEAN | – | – | – | – | – | 1.29 | – | – | 4.20 | 5.00 | – | 3.00 | 6.30 | 8.40 | – | – | – |
| BÖHLER S690 UNLIMITED | – | – | – | – | – | 1.35 | – | – | 4.10 | 5.00 | – | 4.10 | 5.90 | – | – | – | – |
| BÖHLER S790 MICROCLEAN | – | – | – | – | – | 1.29 | – | – | 4.20 | 5.00 | – | 3.00 | 6.30 | – | – | – | – |

| BÖHLER grade | Market grade | Melting route | AMS | Others | Chemical composition in % | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | Si | Mn | Cr | Mo | Ni | V | W | Co | Ti | Al | Nb | Cu | Others |
| **SUPERALLOYS (NI/FE-BASE)** | | | | | | | | | | | | | | | | | | |
| BÖHLER L718 | Alloy 718 | VMR | 5662<br>5663 | 2.4668 | 0.08 | 0.35 | 0.35 | 17–21 | 2.8–3.3 | 50–55 | – | – | 1.0 | 0.65–1.15 | 0.2–0.8 | 4.75–5.5 | 0.3 | P: 0.015<br>S: 0.015<br>Fe: Rem<br>B: 0.006<br>Pb: 5ppm<br>Bi: 0.3 ppm<br>Se: 3ppm |
| BÖHLER L625 | Alloy 625 | VMR | 5666 | 2.4856<br>N06625 | 0.045 | – | – | 15.00 | – | 74.00 | – | – | – | 2.40 | 1.23 | 0.95 | | |
| BÖHLER T200 | A286 | (P)ESR | 5731<br>5732 | Z6NCZ25<br>1.4933<br>1.4944 | ≤0.06 | – | – | 21.00 | 8.50 | 63.90 | – | – | ≤1.00 | ≤0.04 | 0.18 | 3.40 | <3.00 | |


# BÖHLER AMPO POWDER TO PRINT YOUR DREAMS

We as BÖHLER offer powders with the right properties for every application and printing technology. In our global development and testing center we produce test objects with 3D printing in order to acquire experience and explore new application areas for additive manufacturing.

| | **nominally 15 to 45µm, 45 to 90µm, or according to customer requirements**<br>**Titanium: 20 to 63 µm, or according to customer requirements** | | | |
|---|---|---|---|---|
| **BÖHLER AMPO grade** | **Particle size distribution*** **D10** [µm] | **D50** [µm] | **D90** [µm] | **Apparent density**** [g/cm³] |
| BÖHLER E185 AMPO | 18-24 | 29-35 | 42-50 | ≥ 3.5 |
| BÖHLER M789 AMPO | 18-24 | 29-35 | 42-50 | ≥ 3.5 |
| BÖHLER W360 AMPO | 18-24 | 29-35 | 42-50 | ≥ 3.6 |
| BÖHLER N700 AMPO | 18-24 | 29-35 | 42-50 | ≥ 3.4 |
| BÖHLER L718 AMPO | 18-24 | 29-35 | 42-50 | ≥ 3.5 |
| BÖHLER Ti64Gd.5 AMPO | 18-24 | 31-41 | 53-67 | ≥ 2.0 |
| BÖHLER Ti64Gd.23 AMPO | 18-24 | 31-41 | 53-67 | ≥ 2.0 |

* Measurement of the particle size distribution according to ISO 13322-2 (Dynamic image analysis methods);

** The apparent density measurement is based on ASTM B417 and ASTM B212 and relates to typical measured values.

The use of up-to-date measuring technology and investment in new methods is important to us.

Vacuum induction melting and atomization under inert gas ensure the highest possible metallurgical purity of the powder.

In our test laboratory, we rely on qualified and carefully trained staff.

**BÖHLER E185 AMPO** — Patent pending

**Chemical composition [wt. %]**

| Element | C | Si | Mn | Cr | Ni | Mo | V | |
|---|---|---|---|---|---|---|---|---|
| Mass - % | 0.19 | 0.22 | 0.30 | 0.95 | 1.25 | 0.20 | 0.15 | **Co-free*** |

**BÖHLER M789 AMPO** — Patent

**Chemical composition [wt. %]**

| Element | C | Cr | Mo | Ni | Ti | Al | |
|---|---|---|---|---|---|---|---|
| Mass - % | ≤ 0.02 | 12.20 | 1.00 | 10.00 | 1.00 | 0.60 | **Co-free*** |

**BÖHLER W360 AMPO** — Patent

**Chemical composition [wt. %]**

| Element | C | Si | Mn | Cr | Mo | V | |
|---|---|---|---|---|---|---|---|
| Mass - % | 0.50 | 0.20 | 0.25 | 4.50 | 3.00 | 0.55 | **Co-free*** **Ni-free**** |

**BÖHLER N700 AMPO** — DIN 1.4542 / 17-4PH / UNS S17400 (chemistry of AMS 5643 respectively AMS 5622)

**Chemical composition [wt. %]**

| Element | C | Cr | Ni | Cu | Nb |
|---|---|---|---|---|---|
| Mass - % | 0.04 | 16.25 | 4.00 | 4.00 | 0.34 |

**BÖHLER L718 AMPO** — DIN 2.4668 / UNS N07718 (upon request chemistry according to API Std. 6ACRA or AMS 5662 respectively AMS 5663 possible)

**Chemical composition [wt. %]**

| Element | C | Cr | Mo | Ni | Ti | Al | Nb | B | Fe |
|---|---|---|---|---|---|---|---|---|---|
| Mass - % | 0.04 | 19.00 | 3.05 | 52.50 | 0.90 | 0.50 | 5.13 | 0.004 | Balance |

**BÖHLER Ti64Gd.5 AMPO** — 3.7164 (3.7165) UNS 56400

**Chemical composition [wt. %]**

| Element | C | Ti | Al | V | Fe | O | N | H | Y |
|---|---|---|---|---|---|---|---|---|---|
| Mass - % | ≤ 0.08 | > 87.00 | 6.13 | 4.00 | ≤ 0.30 | ≤ 0.20 | ≤ 0.05 | ≤ 0.02 | ≤ 0.01 |

**BÖHLER Ti64Gd.23 AMPO** — 3.7165 (3.7164) UNS 56407

**Chemical composition [wt. %]**

| Element | C | Ti | Al | V | Fe | O | N | H | Y |
|---|---|---|---|---|---|---|---|---|---|
| Mass - % | ≤ 0.08 | > 87.00 | 6.00 | 4.00 | ≤ 0.25 | ≤ 0.13 | ≤ 0.05 | ≤ 0.01 | ≤ 0.01 |

| | |
|---|---|
| **Order quantity** | 10 kg minimum |
| **Particle size distribution** | Nominal 15 to 45 µm, 45 to 90 µm, or customized after request<br>Titanium: 20 to 63 µm, or customized after request |

*Co-content ≤ 0.1%
**Ni-content ≤ 0.1%

# YOU CAN TRUST OUR SPECIALISTS

YOU'VE GOT THE IDEAS AND WE'VE GOT THE SOLUTIONS. ANY PROBLEM THAT ARISES, ANY CUSTOMER REQUIREMENT AT HAND MEANS NEW ANSWERS TO BE FOUND, FOR OVER 100 YEARS NOW. THIS KNOW-HOW IS AVAILABLE TO YOU, WHETHER AS SUPPORT FOR MATERIALS OR AS APPLICATIONS. TECHNICAL CONSULTING IS OUR SUPREME DISCIPLINE AND YOU AS OUR PARTNER CAN CERTAINLY BENEFIT FROM IT.

| **Our services include:** |
|---|
| On-going responsibility for quality (from the inquiry to issuing the certificate) |
| Technical interface between the customer (sales, marketing, …) and the production |
| Technical request handling |
| Technical order processing/inspection/monitoring |
| Product certification (issuing certificates) |
| Product and process approvals/qualifications |
| Continuous product optimization throughout the entire production process |
| Technical customer advisory service/ applications engineering |
| Technical trainings |
| Process optimization and development |
| Central coordination of testing activities |


Market Split High Speed Steel
BÖHLER
voestalpine

# FORMS OF SUPPLY AND AVAILABILITY

## PROMPT AVAILABILITY

Having a professional partner is vital, especially in the field of power industry engineering. In order to be able to fulfill the demands of our customers in terms of time and quantity, we are able to offer special storage options at several locations.

**Austria:**
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E. automotive@bohler-edelstahl.at
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**United Kingdom:**
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P. +44(0)121 552 2575
E. ukinfo@voestalpine.com
www.voestalpine.com/highperformancemetals/uk/en/

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. Measurement data are laboratory values and can deviate from practical analyses. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.

MATERIALS | MACHINING | PVD COATINGS | ADDITIVE

EDRO

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