HOT WORK TOOL STEELS

Application Segments

Hot Work

Available Product Variants

Long Products

Product Description

BÖHLER W403 VMR is a vacuum remelted material which was developed as a problem solver for tools for where a standard solution is no longer sufficient. The steel can be assigned to the 5% chromium steels and has a very high purity due to the special manufacturing technology. In addition, the increased molybdenum content leads to improved thermal resistance as well as wear resistance, which makes BÖHLER W403 VMR an all-rounder that is often used for highly stressed dies in the die casting sector. In addition, Böhler W403 VMR has outstanding polishability. For this reason, the steel is also popular as a molding material for plastic injection molds.

Process Melting

Airmelted + VAR

Properties

- Toughness & Ductility : high
- Wear Resistance : high
- English (United Kingdom) : good
- Hot Hardness (red hardness) : high
- Polishability : very high
- Thermal conductivity : very high
- Micro-cleanliness : very high

Applications

- High Pressure Die-Casting
- Gravity / Low Pressure Die-Casting
- Progressive Forging (Hatebur)
- Glasfibre reinforced plastics
- Forging (Hot / Semi-hot)
- Injection Molding
- Extrusion
- General Components for Mechanical Engineering
- Press Hardening / Hot Stamping
- Mechanical Engineering

Technical data

Material designation	
~1.2367	SEL
~X38CrMoV5-3	EN
C1885	NADCA

Standards	
#207	NADCA

Chemical composition (wt. %)

C	Si	Mn	Cr	Mo	V
0.38	0.20	0.25	5.00	2.80	0.65

Material characteristics

	High temperature strength	High temperature toughness	High temperature wear resistance
BÖHLER W403 VMR	★★★★	★★★★	★★★★
BÖHLER W300 ISOBLOC	★★	★★★★	★★
BÖHLER W300 ISODISC	★★	★★★	★★
BÖHLER W302 ISOBLOC	★★★	★★★★	★★★
BÖHLER W302 ISODISC	★★★	★★★	★★★
BÖHLER W303 ISODISC	★★★★	★★★	★★★★
BÖHLER W350 ISOBLOC	★★★	★★★★★	★★★
BÖHLER W360 ISOBLOC	★★★★★	★★★★	★★★★★
BÖHLER W400 VMR	★★	★★★★★	★★

Delivery condition

Annealed

Hardness (HB)	max. 205

Heat treatment

Annealing

Temperature	750 to 800 °C	Holding time 6 to 8 hours. Slow, controlled furnace cooling at 10 to 20°C/h (50 to 68 °F/hr) to approx. 600°C (1112°F), further cooling in air.

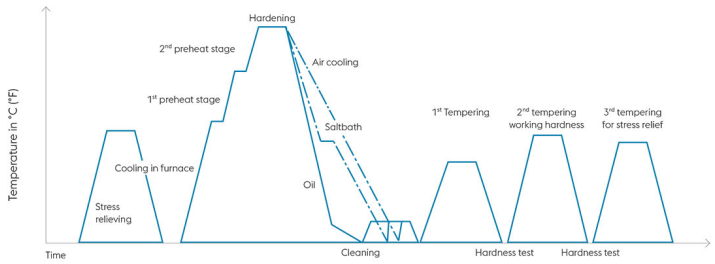
Stress relieving

Temperature	600 to 670 °C	For stress relief after extensive machining or for complicated tools. Holding time depending on tool size after complete heating 2 - 6 hours in neutral atmosphere. Slow furnace cooling.

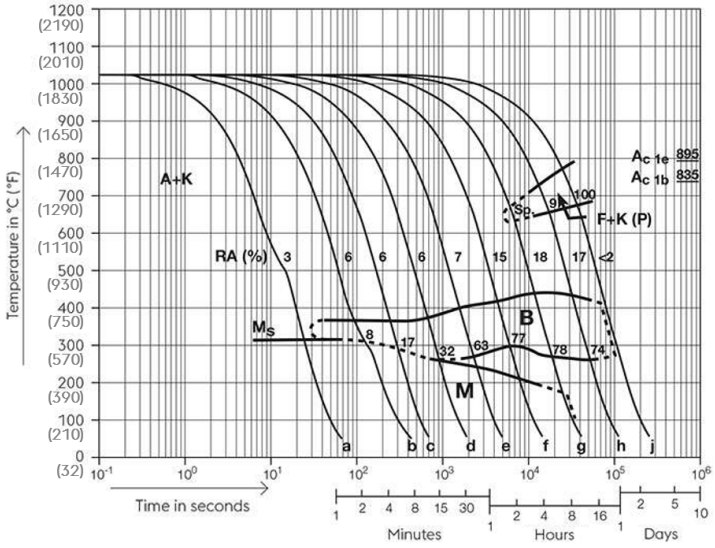
Hardening and Tempering

Temperature	1,020 to 1,030 °C	Holding time after temperature equalization: 15 to 30 minutes; In order to prevent coarsening of the grain, hardening must be carried out at the recommended temperature; Quenching: oil, salt bath (500 - 550°C [930 to 1020 °F}), air, inert gas in vacuum; After hardening, required tempering treatment to achieve desired working hardness (see tempering chart).

Heat treatment sequence



Continuous cooling CCT curves

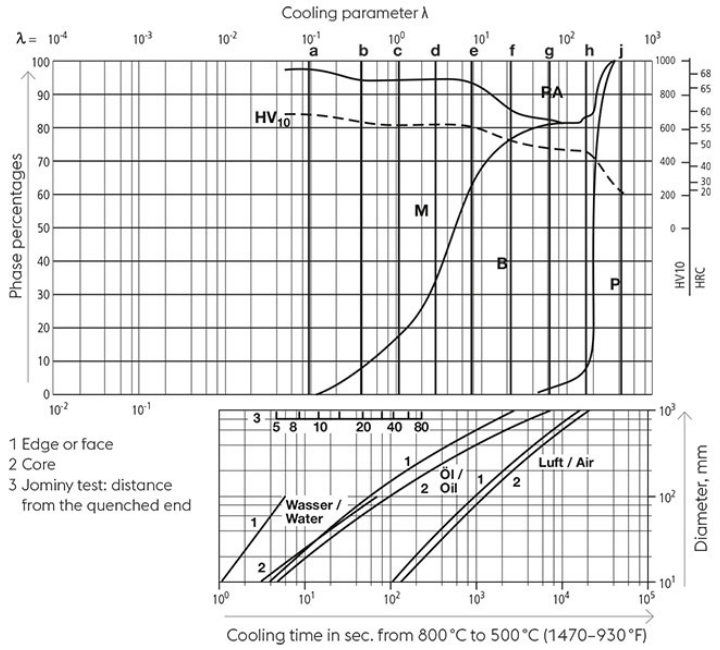


Austenitising temperature: 1025°C (1877°F)
Holding time: 15 minutes
5...100 phase percentages
0.5...180 cooling parameter, i.e. duration of cooling from 800 - 500°C (1472-932°F) in s x 10^{-2}

Table:

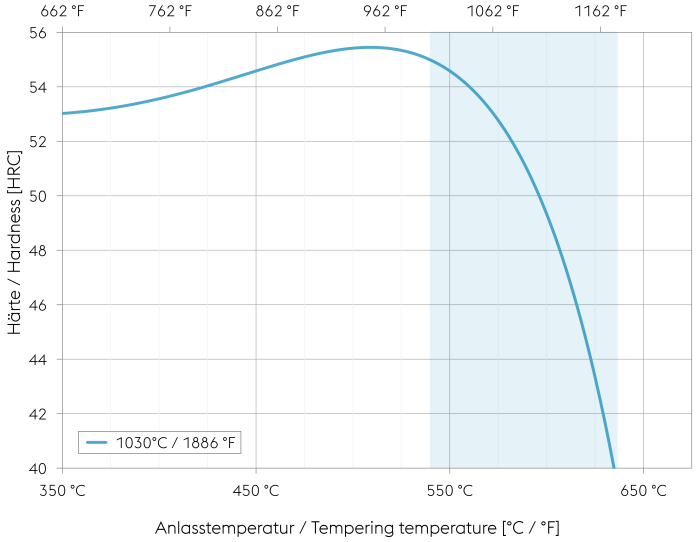
Sample	λ	HV10	Sample	λ	HV10
a	0,1	686	f	23	529
b	0,4	643	g	65	494
c	1,1	619	h	180	465
d	3	624	j	400	234
e	8	615			

Quantitative phase diagram



A... Austenite
B... Bainite
K... Carbide
M... Martensite
P... Perlite
RA... Retained austenite

Tempering chart



Tempering:

Slow heating to tempering temperature immediately after hardening (time in furnace 1 hour for each 0,787 inch (20 mm) of workpiece thickness but at least 2 hours / cooling in air).

It is recommended to temper at least twice.

A third tempering cycle for the purpose of stress relieving may be advantageous.

1st tempering approx. 86°F (30°C) above maximum secondary hardness.

2nd tempering to desired working hardness.
The tempering chart shows average tempered hardness values.

3rd for stress relieving at a temperature 86 to 122°F (30 to 50°C) below highest tempering temperature.

Recommended tempering temperature range is indicated by the blue area in the chart.

Hardening temperature: 1030°C (1886°F)
Specimen size: square 20 mm

Physical Properties

Temperature (°C)	20
Density (kg/dm³)	7.9
Thermal conductivity (W/(m.K))	29.8
Specific heat (kJ/kg K)	0.47
Spec. electrical resistance (Ohm.mm²/m)	-
Modulus of elasticity (10³N/mm²)	211

Thermal Expansions between 20°C | 68°F and ...

Temperature (°C)	100	200	300	400	500	600
Thermal expansion (10^{-6} m/(m.K))	10.6	10.8	12	12.9	14.1	14.3

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ONE STEP AHEAD.