BÖHLER

HOT WORK
TOOL STEEL

HOT WORK TOOL STEEL

BÖHLER W360
ISOBLOC®

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

voestalpine
ONE STEP AHEAD.

HOT WORK TOOL STEEL WITH HIGH HARDNESS

BÖHLER W360 ISOBLOC was developed as a tool steel for dies and punches in warm and hot forging. The steel can be used for a variety of applications where hardness and toughness are required.

Properties

» High hardness (recommended in use: 52 – 57 HRc)
» Exceptional toughness
» High temper resistance
» Good thermal conductivity
» Can be cooled with water
» Homogeneous microstructure

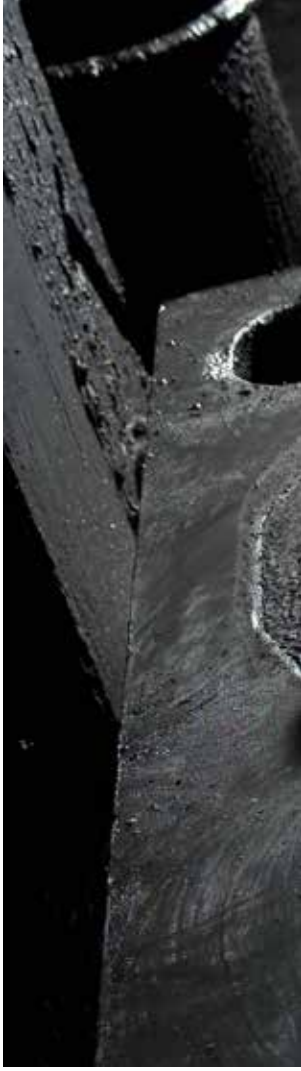
Applications and uses

» Dies and punches in warm and hot forging
» Tooling for high speed presses
» Toughness-critical cold work applications
» Extrusion tooling, e.g. dies
» Core pins and inserts in die-casting dies
» Specific applications in the plastic processing secto

BÖHLER W360 ISOBLOC has been developed to meet the requirements of the market and has the combined advantages of the high hardness of a high speed steel with the very good toughness of a hot work tool steel. These are characteristics which can significantly increase the life-time of your tool.

Product placement

Electroslag remelting ensures a high metallurgical cleanliness and therefore best material properties



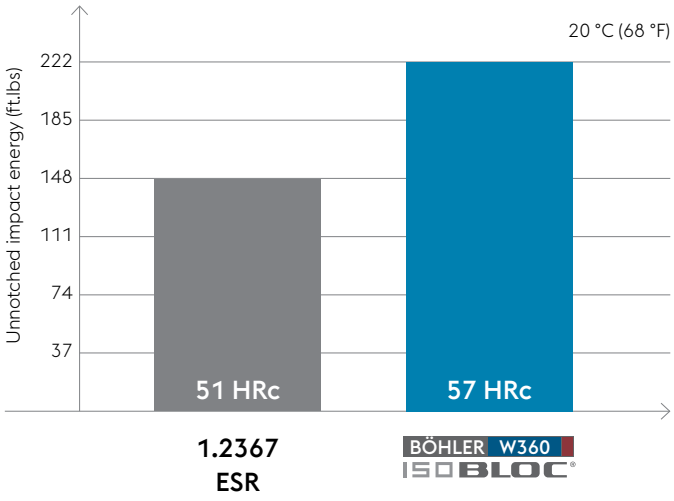
THE COMPARISON SPEAKS FOR ITSELF

BÖHLER W360 ISOBLOC owes its excellent properties to a patented alloying concept and the electroslag remelting process.

TOUGHNESS

The toughness of hot work tool steels is one of the most important properties for safety against fracture and increased resistance to heat-checking and thermal shock. High hardness is usually associated with low toughness. This is not the case for **BÖHLER W360 ISOBLOC**.

Unnotched impact energy



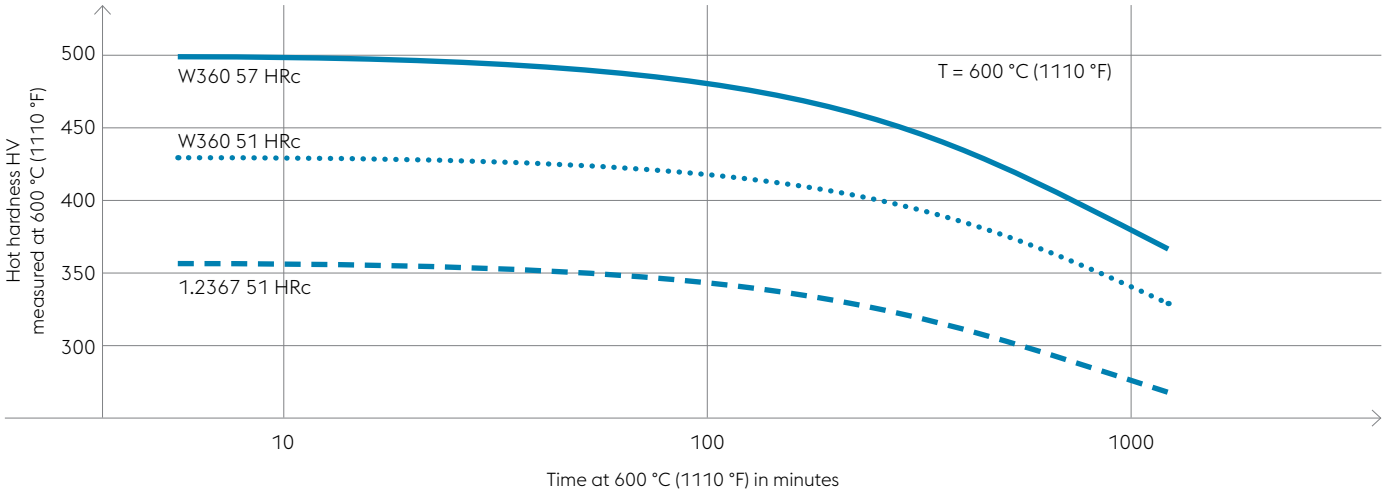
BÖHLER W360 ISOBLOC has a significantly higher toughness than 1.2367 ESR – at a higher hardness.

COMPARISON OF THE MAJOR STEEL PROPERTIES

HOT HARDNESS

Alongside the outstanding toughness, **BÖHLER W360 ISOBLOC** is distinguished by its high thermal stability. This is reflected in the high hot hardness and the stability of the material under thermal loading. These properties, combined in **BÖHLER W360 ISOBLOC**, ensure a high resistance to thermal fatigue and catastrophic failure.

Hot hardness



At 51 HRC, **BÖHLER W360 ISOBLOC** has a higher hot hardness than 1.2885 and 1.2367. If the hardness of **BÖHLER W360 ISOBLOC** is increased to 57 HRc, then the result is a further increase in the hot hardness.

NUMBERS, DATA, FACTS

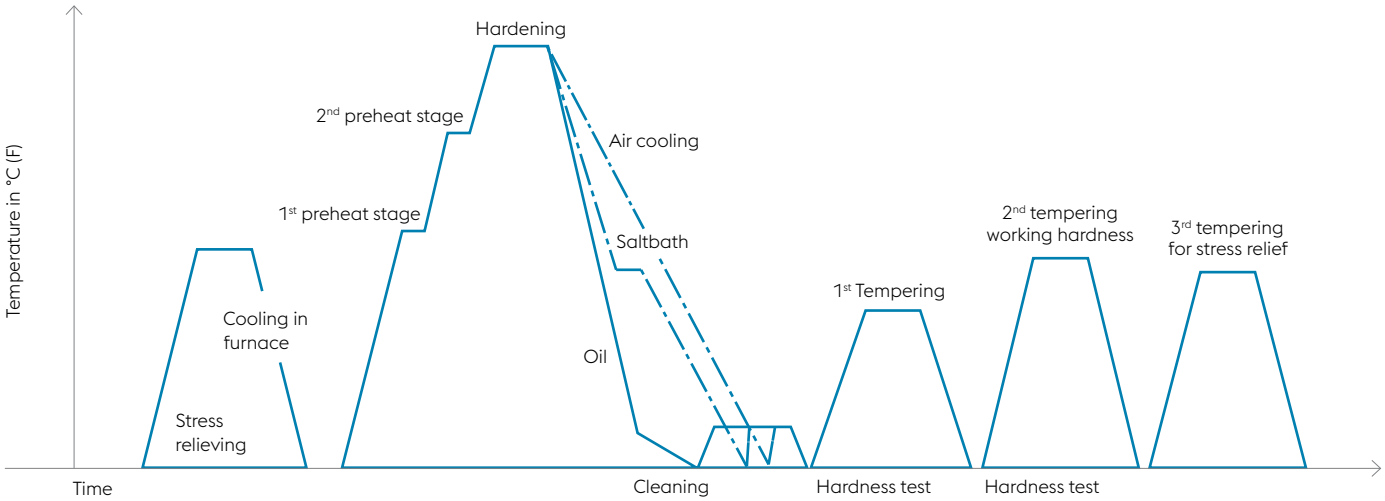
FROM LABORATORY TO CUSTOMER

voestalpine BÖHLER recognises cost effectiveness of tooling as a central concern during the development process.
The facts and figures of **BÖHLER W360 ISOBLOC** at a glance.

Chemical composition (average %)

C	Si	Mn	Cr	Mo	V
0.50	0.20	0.25	4.50	3.00	0.55

Heat treatment sequence



HEAT TREATMENT RECOMMENDATIONS

Supplied condition
» Annealed, 205 HB max.

HEAT TREATMENT

Annealing
» 750 bis 800 °C (1380 to 1470 °F), Holding time 6 to 8 hours
» Slow, controlled cooling in furnace at a rate of 10 to 20 °C/h (50 to 68 °F/h) down to approx. 600 °C (1110 °F), further cooling in air.

Stress relieving
» 650 bis 700 °C (1200 to 1290 °F)
» After through-heating, soak for 1 to 2 hours in a neutral atmosphere.
» Cool slowly in furnace.

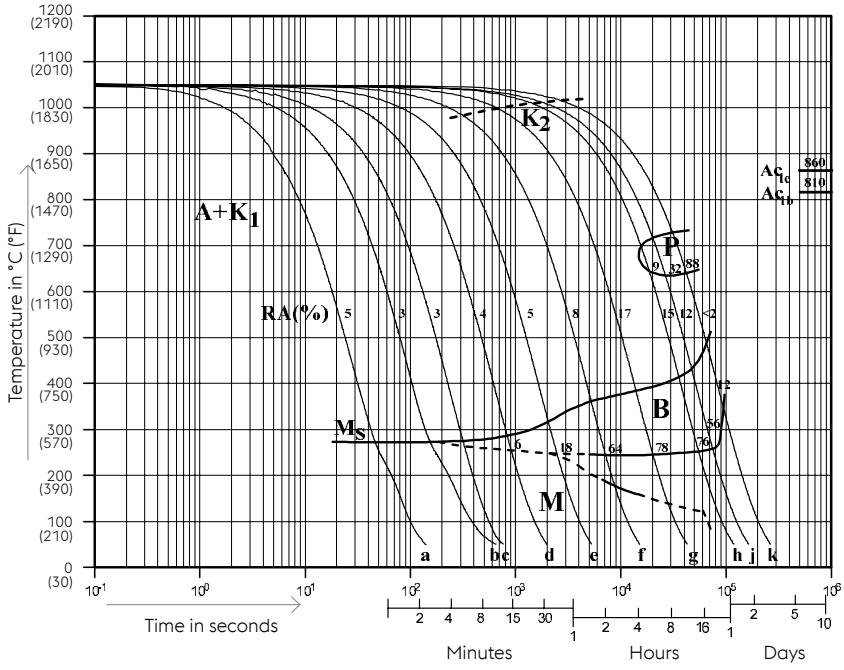
Hardening
» 1050 °C (1920 °F)/oil, salt bath 500 bis 550 °C (930 to 1020 °F), air, vacuum furnace with gas quenching
» Holding time after through-heating: 15 to 30 minutes

Tempering (according to tempering chart)
» Slowly heat to tempering temperature immediately after hardening
» Time in furnace: 1 hour for every 20 mm of workpiece thickness but at least 2 hours. Cool in air.
» We recommend that the steel be tempered at least 3 times.

Continuous cooling CCT curves

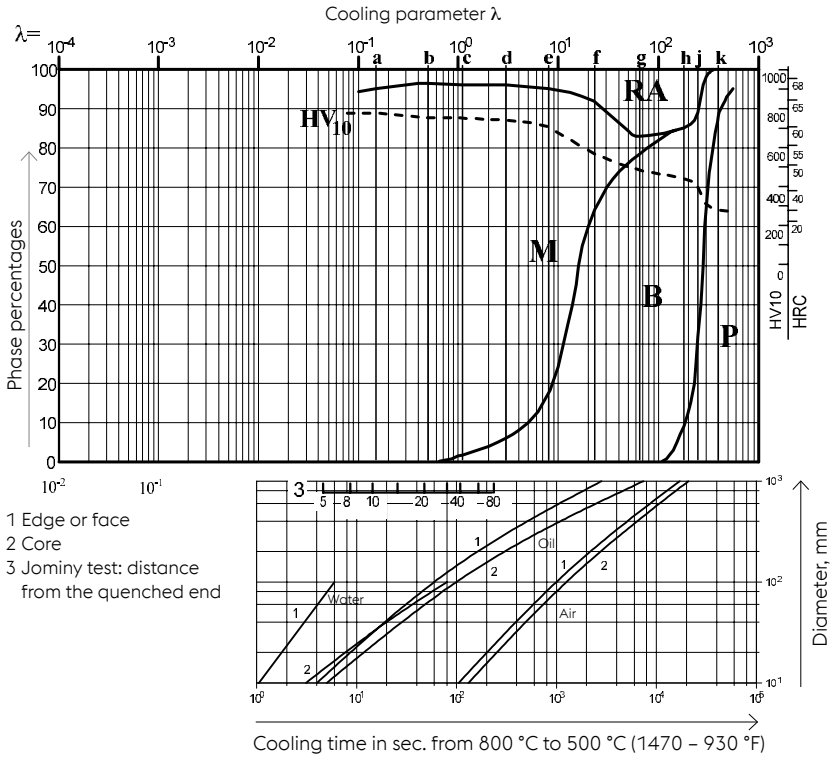
Austenitizing temperature: 1050 °C (1920 °F)
Holding time: 30 minutes
5 ... 100 phase percentages
0.15 ... 400 cooling parameter (λ), i.e. duration of cooling from 800 – 500° C (1470 – 930 °F) in s x 10^{-2}

Sample	λ	HV_{10}
a	0.15	785
b	0.50	760
c	1.10	762
d	3.00	754
e	8.00	724
f	23.00	582
g	65.00	498
h	180.00	453
j	250.00	415
k	400.00	294



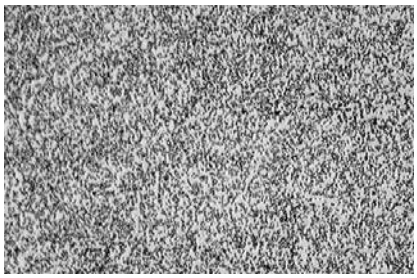
Quantitative phase diagram

$K_{1,2}$	Carbide
RA	Retained austenite
A	Austenite
M	Martensite
P	Perlite
B	Bainite



1 Edge or face
2 Core
3 Jominy test: distance from the quenched end

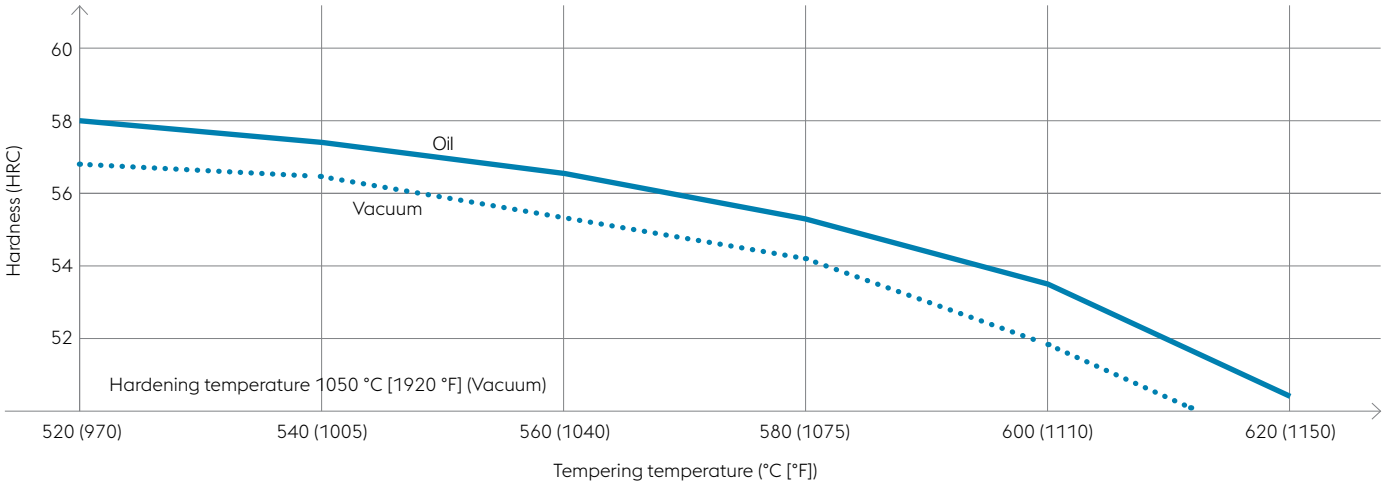
Annealed microstructure



BÖHLER W360 ISOBLOC 0 10 µm

BEST PROPERTIES

Tempering chart



Physical properties

Density at	20 °C 68 °F	7.6 kg/dm^3 0.274 lbs/in^3
Electrical resistivity at	20 °C 68 °F	0.59 Ohm.mm^2/m 0.98 x 10^{-3} Ohm circular-mil per ft

Condition: hardened and tempered

Thermal conductivity

100 °C	**200 °C**	**300 °C**	**400 °C**	**500 °C**	
31.5	32.3	32.6	32.5	31.9	W/(m.K)
210 °F	**390 °F**	**570 °F**	**750 °F**	**930 °F**	
18.2	18.7	18.8	18.8	18.4	Btu/ in/ft^2 h°F

Thermal expansion between 20 °C (68 °F) and ... °C (°F)

100 °C	**200 °C**	**300 °C**	**400 °C**	**500 °C**	**600 °C**	**700 °C**	
11.1	11.5	11.9	12.3	12.8	13.2	13.6	10^{-6} m/(m.K)
210 °F	**390 °F**	**570 °F**	**750 °F**	**930 °F**	**1110 °F**	**1290 °F**	
6.2	6.4	6.6	6.8	7.1	7.3	7.6	10^{-6} in/in °F

MACHINING RECOMMENDATIONS

Turning with sintered carbide

Depth of cut mm (inches)	0.5 – 1 (.02 – .04)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)	over 8 (over .31)
Feed mm / rev. (inches/rev.)	0.1 – 0.3 (.004 – .012)	0.2 – 0.4 (.008 – .016)	0.3 – 0.6 (.012 – .024)	0.5 – 1.5 (.020 – .060)
BOEHLERIT grade	SB10, SB20	SB10, SB20, SB30	SB30, EB20	SB30, SB40
ISO grade	P10, P20	P10, P20, P30	P30, M20	P30, P40
Cutting speed v_c m/min (f.p.m)				
Indexable inserts **Tool life: 15 min.**	310 – 200 (1015 – 655)	220 – 130 (720 – 425)	180 – 100 (590 – 330)	120 – 50 (395 – 165)
Brazed carbide tools **Tool life: 30 min.**	260 – 150 (850 – 490)	210 – 100 (690 – 330)	130 – 85 (425 – 280)	90 – 50 (295 – 165)
Coated indexable inserts **Tool life: 15 min.** **BOEHLERIT ROYAL 121** **BOEHLERIT ROYAL 131**	 up to 300 (980) up to 240 (790)	 up to 270 (885) up to 175 (575)	 up to 195 (640) up to 135 (445)	 up to 125 (410) up to 70 (230)
Tool angles for brazed carbide tools				
Clearance angle	12°	12°	12°	12°
Rake angle	6° – 8°	6° – 8°	6° – 8°	6° – 8°
Inclination angle	0°	–4°	–4°	–4°

Condition: annealed, figures given are guidelines only

Turning with high speed steel

Depth of cut mm (inches)	0.5 (.02)	3 (.12)	6 (.24)	10 (.40)	over 10 (.40)
Feed mm / rev. (inches/rev.)	0.1 (.004)	0.5 (.020)	1.0 (.040)	1.5 (.060)	over 1.5 (.060)
HSS-grade BÖHLER/DIN	S700 / DIN S10-4-3-10				
Cutting speed v_c m/min (f.p.m)					
Tool life: 60 min.	45 – 30 (150 – 100)	30 – 22 (100 – 70)	22 – 18 (70 – 60)	18 – 12 (60 – 40)	16 – 8 (50 – 25)
Rake angle **Clearance angle** **Inclination angle**	14° 8° 0°	14° 8° 0°	14° 8° –4°	14° 8° –4°	14° 8° –4°

Milling with inserted tooth cutter

Feed mm/tooth (inches/tooth)	up to 0.2 (.008)	0.2 – 0.4 (.008 – .016)
Cutting speed v_c m/min (f.p.m)		
BOEHLERIT SBF / ISO P25	150 – 100 (490 – 330)	110 – 60 (360 – 195)
BOEHLERIT SB40 / ISO P40	100 – 60 (330 – 195)	70 – 40 (230 – 130)
BOEHLERIT ROYAL 131 / ISO P35	130 – 85 (425 – 280)	–

Drilling with inserted carbide

Drill diameter mm (inches)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed mm / rev. (inches/rev.)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BOEHLERIT/ISO grade	HB10 / K10		
Cutting speed v_c m/min (f.p.m)	50 – 35 (165 – 115)	50 – 35 (165 – 115)	50 – 35 (165 – 115)
Point angle	115° – 120°	115° – 120°	115° – 120°
Clearance angle	5°	5°	5°

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