BÖHLER

BOHLER W302 ISOBLOC®

Premium H13 Hot Work Tool Steel

BOHLER W302 ISOBLOC®

Chemical Composition (Average %)

C	Si	Mn	Cr	Mo	V	S
0.39	1.10	0.40	5.20	1.40	0.95	≤0.003

Standard

AISI	DIN	JIS	ISO
H13	1.2344	SKD61	40CrMoV5

Properties

A premium grade H13 hot work tool steel featuring:

- Very good toughness properties meeting the requirements of NADCA 207-97
- Very good heat checking resistance
- Good temper resistance and high temperature strength
- Excellent polishability and texturability

The term ISOBLOC refers to BOHLER'S unique processing method which includes electro-slag remelting (ESR) to obtain a steel with superior mechanical properties.

Application

Dies, cores and inserts for the high pressure die casting of aluminum, magnesium and zinc alloys.

Hot forging, shearing, pressing and extrusion tooling including: dies, die holders, liners and stems.

The excellent polishability and toughness properties of W302 ISOBLOC also make it an excellent choice for demanding plastic molding applications.

Heat Treatment*

Annealing:

Under protective atmosphere, heat through to 1560°F (850°C). Slow, controlled cooling in the furnace at a rate of 20 -40°F/hour (10 to 20°C/hr) down to 1200°F (650°C), continue cooling in air.
Hardness after annealing:
maximum 229 HB

Stress Relieving:

Intended to relieve stresses created by rough machining. Under protective atmosphere heat through to 1200°F (650°C), hold for two hours. Cool slowly in furnace to 930°F (500°C), continue cooling in air.

Hardening (under protective atmosphere):

Initial preheat: heat through to 1200°F (650°C)
Second preheat: heat through to 1550°F (840°C)
Hardening temperature: 1870-1920°F (1020-1050°C)

Temperature	Soak Time	As-Quenched Hardness
1870°F (1020°C)	30 min.	53± 2 HRC
1920°F (1050°C)	15 min.	54± 2 HRC

Quenching:

Vacuum: Using an inert gas at positive pressure, quench as rapidly as possible to avoid unwanted transformation products. Complex tool geometries and thick cross sections may require an interrupted (i.e.,step) quench procedure.

Salt Bath/Fluidized Bed: Quench to 930-1020°F (500-550°C), equalize, then cool in air.

Oil: Quenching in warm oil should be limited to small, uncomplicated tooling. Note, there is a high risk for cracking and/or excessive distortion.

Regardless of quenching media, tool must be tempered immediately after reaching 150°F (65°C).

*Note: Leave adequate machine stock prior to heat treatment to allow for any dimensional changes or distortion which may occur.

Impact Toughness of BOHLER W302 ISOBLOC®

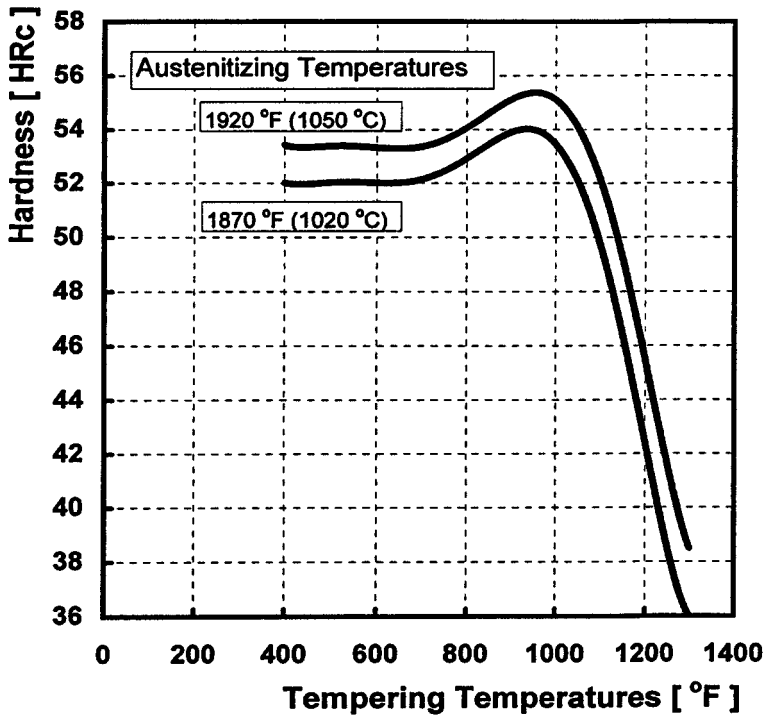
BOHLER W302 ISOBLOC® meets the North American Die Casting Association (NADCA) specification for premium H13 die steel and is guaranteed to meet an average minimum 8 ft-lbs. Charpy V-notch value.

Tempering Curve

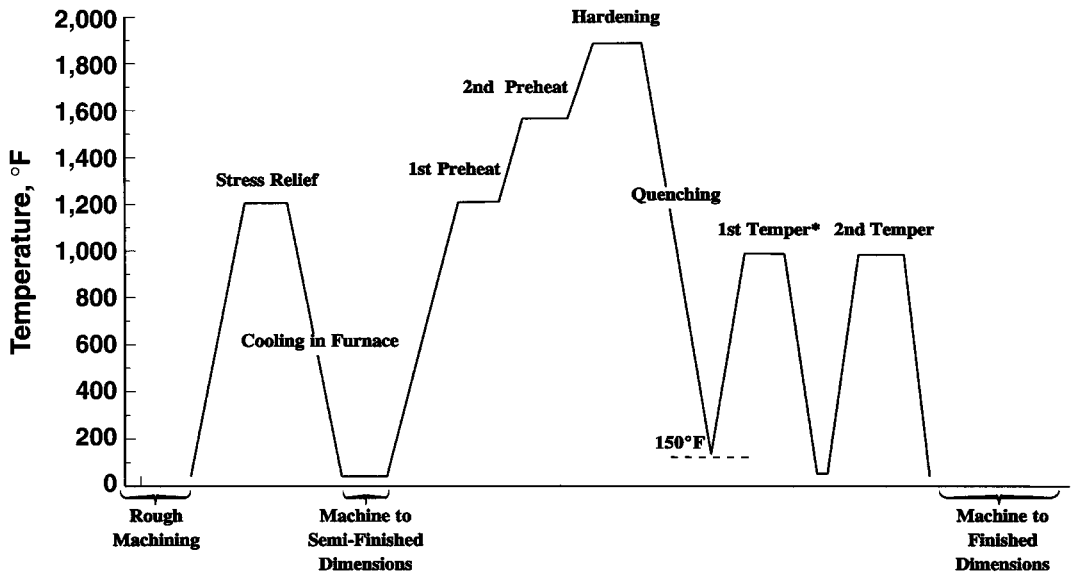
Tempering:

Select the tempering temperature from the graph based on the hardness requirements. A minimum of two tempers with intermediate cooling to room temperature is required. For optimum properties, avoid tempering in the range of 800-980°F (425°-525°C).

Holding time one hour per inch of wall thickness or hold at temperature for a minimum of two hours.



Heat Treatment Sequence



***Immediately begin 1st temper once tool has been quenched to 150°F**

BOHLER W302 ISOBLOC®

CCT Diagram

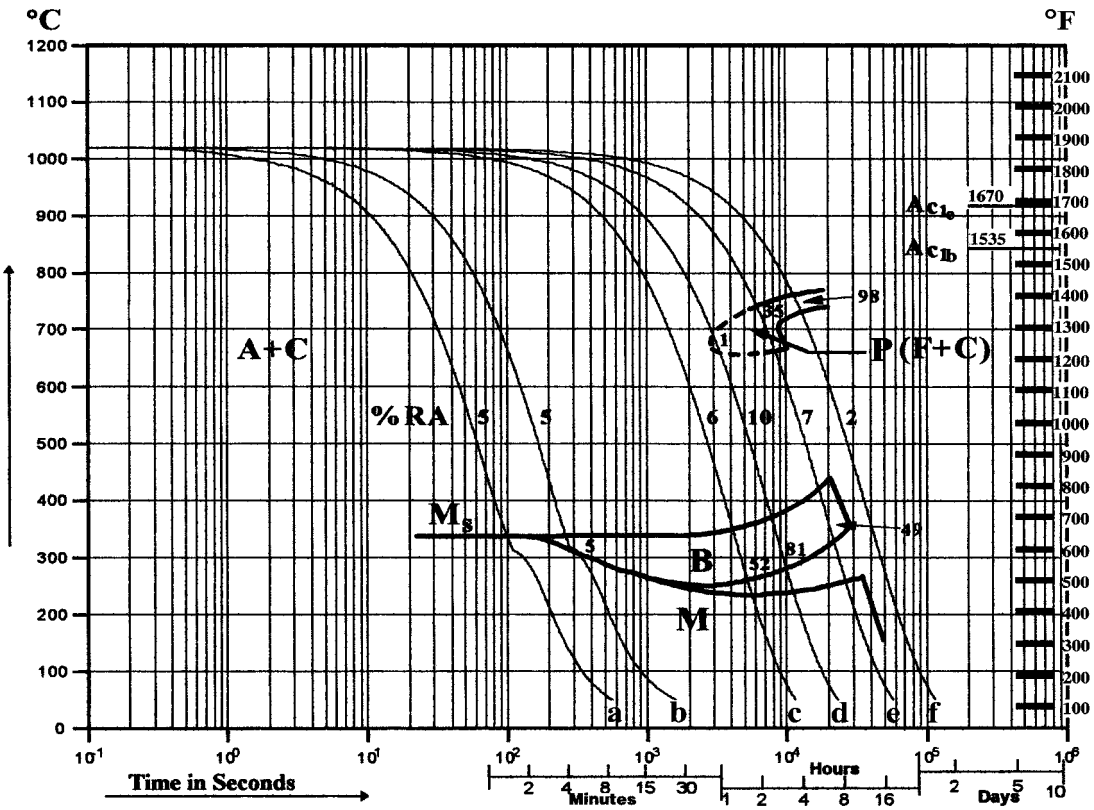
Chemical composition %:

C	Si	Mn	P	S	Cr	Mo	Ni	V	W
0.43	0.90	0.37	0.018	0.003	4.98	1.22	0.27	1.03	0.05

Austenitizing temperature: 1870°F (1020°C)
Holding time: 15 minutes

Cooling Curve	λ	HV10 (Vickers Hardness)
a	0.4	568
b	1.03	590
c	18	598
d	36	520
e	90	410
f	180	215

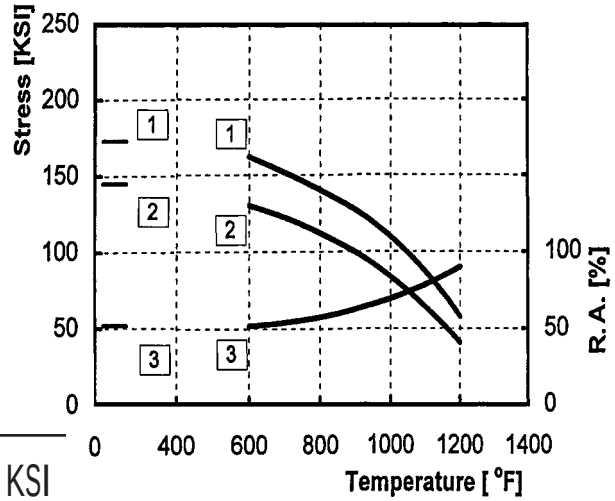
λ: Duration of cooling from 1470-930°F (800°-500°C) in seconds x 10^{-2}



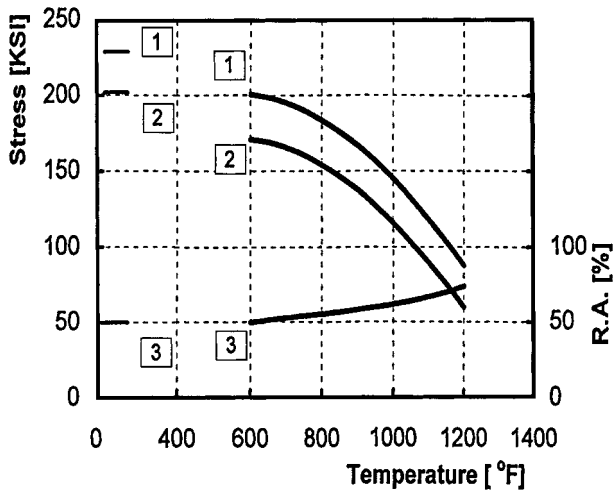
Hot Strength Chart

1 . . . . . .Tensile strength
2 . . . . . .0.2% proof stress
3 . . . . . .Reduction of area %

Heat Treated to 175 KSI



Heat Treated to 230 KSI



Surface Treatment

Nitriding:

Suitable for bath, gas or plasma/ion nitriding and nitrocarburizing. The surface treatment temperature must be maintained at 50-90°F (10-30°C) below the last tempering temperature of the tool. The case depth should be limited to a maximum of .003 inches (0.1 mm) for hot work applications and the formation of a "white-layer" must be avoided.

Repair Welding

Weld repairs may be performed successfully when proper procedures are followed.

Preheat and Interpass Temperature:
620-710°F (325-375°C)

Filler Metal: AISI H13-type

Post Weld Heat Treatment:

Hardened Condition: Stress temper at 50-90°F (10-30°C) below the last tempering temperature.

Annealed Condition: Perform annealing procedure, as specified in heat treatment section, prior to hardening.

Electrical Discharge Machining:

When the EDM process is performed on a tool in the hardened condition, a brittle, re-solidified layer will be formed on the die surface. The surface integrity of the die should be improved as follows:

1) All cavity surfaces must be stoned/ polished to remove the brittle layer.
2) A "stress temper" at 50-90°F (10-30°C) below the last tempering temperature of the tool should be performed after polishing.

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Recommendation for machining

(Annealed condition, average values)

Turning with carbide tipped tools

depth of cut, inches (mm)	.02–.04 (0.5-1)	.04-.16 (1-4)	.16-.31 (4-8)	>.31 (>8)
feed, inches/rev, (mm/rev)	.004–.012 (.1–.3)	.008-.016 (.2-.4)	.012-.024 (.3-.6)	.020-.060 (.5-1.5)
US Grade (ISO Grade)	C6, C7 (P10, P20)	C5, C6, C7 (P10, P20, P30)	C5 (P30, M20)	C5 (P30, P40)
cutting speed—				
indexable carbide inserts				
edge life 15 min., fpm (m/min.)	655-1020 (200-310)	425-720 (130-220)	330-590 (100-180)	160-390 (50-120)
brazed carbide tipped tools				
edge life 30 min., fpm (m/min.)	490-850 (150-260)	330-690 (100-210)	280-425 (85-130)	160-295 (50-90)
cutting angles for brazed carbide tipped tools—				
clearance angle	6 to 8°	6 to 8°	6 to 8°	6 to 8°
rake angle	12°	12°	12°	12°
angle of inclination	0°	-4°	-4°	-4°

Turning with HSS tools

depth of cut, inches (mm)	.02 (.5)	.12 (3)	.24 (6)	.40 (10)	>.4 (>10)
feed, inches/rev, (mm/rev)	.004 (.1)	.002 (.5)	.04 (1.0)	.06 (1.5)	> .06 (>1.5)
HSS-grade BOHLER	S700/S10-4-3-10				
cutting speed—					
edge life 60 min., fpm (m/min.)	100-150 (30-45)	70-100 (22-30)	60-70 (18-22)	40-60 (12-18)	25-40 (8-16)
rake angle	14°	14°	14°	14°	14°
clearance angle	8°	8°	8°	8°	8°
angle of inclination	0°	0°	-4°	-4°	-4°

Milling with carbide tipped cutters

feed, inches/tooth, (mm/tooth)	to .008 (to .2)	.008-.016 (.2 to .4)
cutting speed, fpm (m/min)		
US grade C6 (ISO Grade P25)	330-490 (100-150)	200-360 (60-110)
US grade C5 (ISO Grade P40)	200-300 (60-100)	130-230 (40-70)

Drilling with carbide tipped tools

drill diameter, inches (mm)	.12-.31 (3-8)	.31-.80 (8-20)	.80-1.6 (20-40)
feed, inches/rev, (mm/rev)	.001-.002 (.02-.05)	.002-.005 (.05-.12)	.005-.007 (.12-.18)
US Grade (ISO Grade)	C3 (K10)	C3 (K10)	C3 (K10)
cutting speed, fpm (m/min)	115-160 (35-50)	115-160 (35-50)	115-160 (35-50)
top angle	115 to 120°	115 to 120°	115 to 120°
clearance angle	5°	5°	5°

Physical Properties

Density at	70°F (20°C)	.282 lbs/in³ (7.8 g/cm³)
	930°F (500°C)	.276 lbs/in³ (7.64 g/cm³)
	1100°F (600°C)	.275 lbs/in³ (7.60 g/cm³)
Specific heat at	70°F (20°C)	.110 Btu/lb°F 460 (J/kg K)
	930°F (500°C)	.131 Btu/lb°F 550 (J/kg K)
	1100°F (600°C)	.141 Btu/lb°F 590 (J/kg K)
Electric resistivity at	70°F (20°C)	0.020 Ohm x in²/in (0.52 Ohm mm²/mm)
	930°F (500°C)	0.034 Ohm x in²/in (0.86 Ohm mm²/mm)
	1100°F (600°C)	0.038 Ohm x in²/in (0.96 Ohm mm²/mm)
Modulus of elasticity at	70°F (20°C)	31.2 x 10^6psi (215 x 10^3 N/mm²)
	930°F (500°C)	25.5 x 10^6psi (176 x 10^3 N/mm²)
	1100°F (600°C)	23.9 x 10^6psi (165 x 10^3 N/mm²)

Thermal expansion between 70°F and—

in/in °F x 10^{-6} from 70°F to: (m/m °C x 10^{-6} from 20°C to:)

200°F (100°C)	400°F (200°C)	570°F (300°C)	750°F (400°C)	930°F (500°C)	1100°F (600°C)	1300°F (700°C)
6.4 (11.5)	6.7 (12.0)	6.8 (12.2)	6.9 (12.5)	7.2 (12.9)	7.2 (13.0)	7.3 (13.2)

Thermal conductivity at 70°F and—

Btu/ft • h • °F from 70°F to : (W/m °C from 20°C to:)

70°F (20°C)	200°F (100°C)	400°F (200°C)	570°F (300°C)	750°F (400°C)	930°F (500°C)	1100°F (600°C)	1300°F (700°C)
Annealed Condition							
15.5 (26.8)	15.7 (27.2)	16.2 (28.1)	17.4 (30.1)	17.9 (31.0)	18.2 (31.5)	18.7 (32.3)	19.3 (33.4)
Hardened Condition							
14.4 (25.0)	14.7 (25.5)	15.6 (27.1)	15.9 (27.5)	16.0 (27.70)	16.3 (28.3)	16.9 (29.3)	17.5 (30.4)

As regards to applications and processing steps that are not expressly mentioned in this product description/data sheet, the customer shall in each individual case be required to consult us.

BD 65 - 05/01/750

To purchase Bohler and Uddeholm products
please contact:

BÖHLER UDDEHOLM

2595 Meadowvale Blvd.
Mississauga, ON L5N 7Y3
www.bucanada.ca
e-mail: info@bucanada.ca

Sales:
Tel (800) 665-8335
Fax (905) 812-8658