

HOT WORK TOOL STEELS

Available Product Variants

- Long Products*
- Plates
- Open Die Forgings

*) Presented data refer exclusively to long products. Please observe the detailed explanations at the end of the data sheet (pdf).

Product Description

BÖHLER W350 ISOBLOC is a material produced by the electroslag remelting process (ESR) which is particularly suitable for use in large casting and forging molds. Although the steel can be classified as a 5% chromium steel, the chemical composition has been chosen to provide the best possible through-hardening without any loss of toughness or resistance against heat-checkings. These properties make the steel the perfect choice to produce very large die casting molds, for example for mega- or giga-casting.

Process Melting

- Airmelted + Remelted

Properties

- > Toughness & Ductility : very high
- > Wear Resistance : high
- > Machinability : very high
- > Hot Hardness (red hardness) : high
- > Polishability : very high
- > Thermal conductivity : very high
- > Micro-cleanliness : high

Applications

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

Technical data

Material designation		Standards	
BÖHLER patent	Market grade	#207	NADCA
E1850	NADCA		

Chemical composition (wt. %)

C	Si	Mn	Cr	Mo	V	N
0.38	0.20	0.55	5.00	1.80	0.55	def.

Material characteristics

	High temperature strength	High temperature toughness	High temperature wear resistance
BÖHLER W350 ISOBLOC®	★★★	★★★★★	★★★
BÖHLER W300 ISOBLOC®	★★	★★★★	★★
BÖHLER W300 ISODISC®	★★	★★★	★★
BÖHLER W302 ISOBLOC®	★★★	★★★★	★★★
BÖHLER W302 ISODISC®	★★★	★★★	★★★
BÖHLER W303 ISODISC®	★★★★	★★★	★★★★
BÖHLER W320 ISODISC®	★★★	★★	★★★
BÖHLER W360 ISOBLOC®	★★★★★	★★★★	★★★★★
BÖHLER W400 VMR®	★★	★★★★★	★★
BÖHLER W403 VMR®	★★★★	★★★★	★★★★

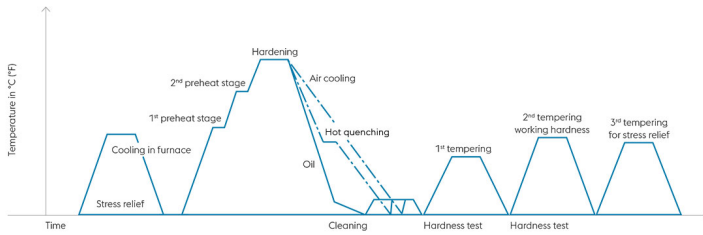
Delivery condition

Annealed	
Hardness (HB)	max. 205

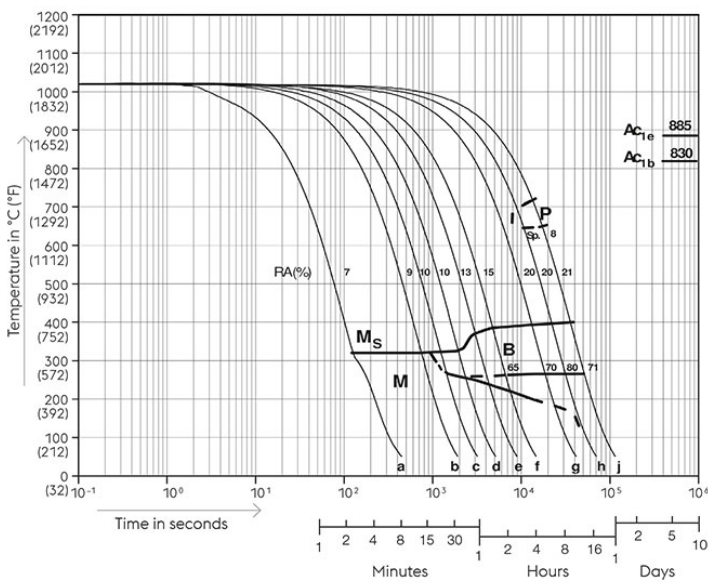
Heat treatment

Annealing		
Temperature	800 to 850 °C 1,472 to 1,562 °F	Slow controlled cooling in furnace at a rate of 10 to 20 °C/hr (50 to 68 °F/hr) down to approx. 600 °C (112 °F), further cooling in air.
Stress relieving		
Temperature	600 to 670 °C 1,112 to 1,238 °F	Slow cooling furnace. To relieve stresses caused by extensive machining, or for complex shapes. Soak for 1 -2 hours after temperature equalisation (in neutral atmosphere).
Hardening and Tempering		
Temperature	1,010 to 1,020 °C 1,850 to 1,868 °F	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. For big dimensions it's recommended to reduce the temperature to 1010 °C (1850 °F); Quenching: oil, salt bath (500 - 550°C [932 - 1022 °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

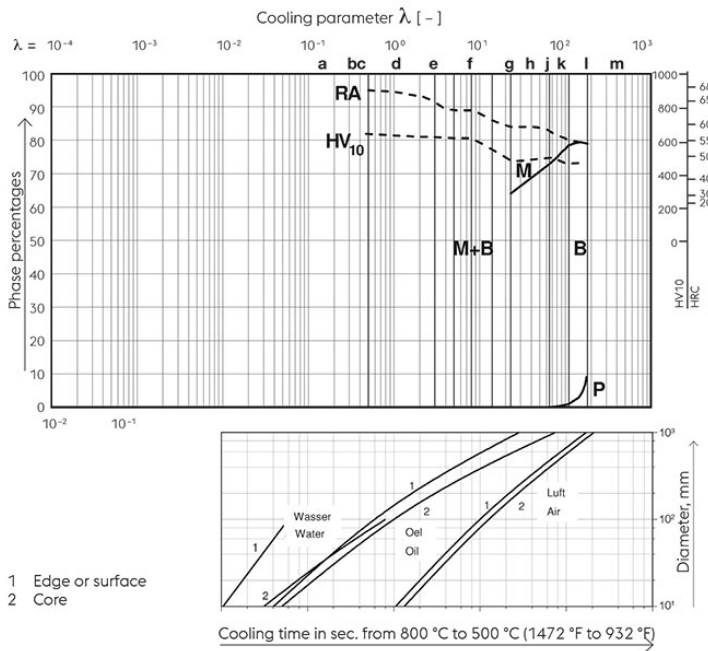


Austenitising temperature: 1020°C (1868°F)
 Holding time: 15 minutes
 5...100 phase percentages
 0.5...180 cooling parameter, i.e. duration of cooling
 from 800 - 500°C (1472-932°F) in s x 10⁻²

Table:
 Sample λ HV10

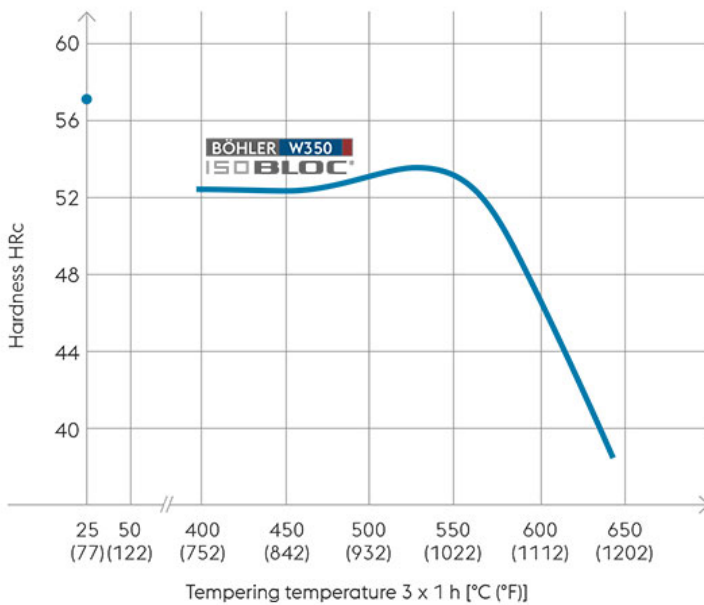
a	0,50	630
b	3	616
c	5	606
d	8	606
e	14	517
f	23	478
g	65	497
h	110	454
j	180	459

Quantitative phase diagram



A... Austenite
B... Bainite
K... Carbide
M... Martensite
P... Pearlite
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.

Hardening temperature: 1020°C (1868°F)
Specimen size: square 20 mm

Physical Properties

Temperature (°C °F)	20 68
Density (kg/dm ³ lb/in ³)	7.8 0.28
Thermal conductivity (W/(m.K) BTU/ft h °F)	28.8 16.64
Specific heat (kJ/kg K BTU/lb °F)	0.46 0.1099
Spec. electrical resistance (Ohm.mm ² /m 10 ⁻⁴ Ohm.inch ² /ft)	-
Modulus of elasticity (10 ³ N/mm ² 10 ³ ksi)	214 31.04

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

Temperature (°C °F)	100 212	200 392	300 572	400 752	500 932	600 1,112	700 1,292
Thermal expansion (10 ⁻⁶ m/(m.K) 10 ⁻⁶ inch/inch.°F)	11.14 6.2	11.94 6.6	12.42 6.9	12.85 7.1	13.21 7.3	13.51 7.5	13.58 7.5

Long Products: For additional specifications and technical requirements, please contact our regional voestalpine BÖHLER sales companies.

Open Die Forgings: Product Variant may differ in terms of melting process, technical data, delivery, and surface condition as well as available product dimensions. Please contact the business unit Open Die Forgings of voestalpine BÖHLER Edelstahl GmbH & Co KG.

Sheet & Plates: Product Variant may differ in terms of melting process, technical data, delivery, and surface condition as well as available product dimensions. Please contact voestalpine BÖHLER Bleche GmbH & Co KG.

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