BÖHLER

BÖHLER S690 MICROCLEAN®

# HIGH SPEED STEELS

## Available Product Variants

Long Products* | Plates

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

## Product Description

**BÖHLER S690 MICROCLEAN – "The simple one"**
The tough high-speed steel for challenging machining and cold forming.

## Process Melting

Powder metallurgy

## Properties

- Toughness & Ductility : very high
- Wear Resistance : good
- Compressive strength : good
- Edge Stability : good
- Grindability : high
- Hot Hardness (red hardness) : good

## Applications

- Automotive Racing
- End Mills
- Special Cutting Tools
- Broaches and Reamers
- Fine Blanking, Stamping, Blanking
- Cold Forming / Coining
- Powder Pressing

## Technical data

| Material designation | |
|---|---|
| ~M4 | AISI |
| ~HS6-5-4 | EN |

## Chemical composition (wt. %)

| C | Cr | Mo | V | W |
|---|---|---|---|---|
| 1.44 | 4 | 5 | 4 | 5.5 |

## Material characteristics

| | Compressive strength | Grindability | Red hardness | Toughness | Wear resistance | Edge Stability |
|---|---|---|---|---|---|---|
| BÖHLER S690 MICROCLEAN® | ★★★ | ★★★ | ★★ | ★★★★★ | ★★★ | ★★ |
| BÖHLER S290 MICROCLEAN® | ★★★★★ | ★ | ★★★★ | ★★ | ★★★★★ | ★★★★ |
| BÖHLER S390 MICROCLEAN® | ★★★★ | ★★★ | ★★★★ | ★★★★ | ★★★★ | ★★★★ |
| BÖHLER S393 MICROCLEAN® | ★★★★ | ★★★ | ★★★★ | ★★★★ | ★★★★ | ★★★★ |
| BÖHLER S590 MICROCLEAN® | ★★★★ | ★★★ | ★★★★ | ★★★ | ★★★ | ★★★ |
| BÖHLER S592 MICROCLEAN® | ★★★★ | ★★★ | ★★★★ | ★★★ | ★★★ | ★★★ |
| BÖHLER S692 MICROCLEAN® | ★★★ | ★★★ | ★★ | ★★★★★ | ★★★ | ★★ |
| BÖHLER S790 MICROCLEAN® | ★★★ | ★★★ | ★★ | ★★★★ | ★★ | ★★★ |
| BÖHLER S792 MICROCLEAN® | ★★★ | ★★★ | ★★ | ★★★★ | ★★ | ★★★ |
| BÖHLER S793 MICROCLEAN® | ★★★ | ★★★ | ★★★★ | ★★★ | ★★★ | ★★★ |

## Delivery condition

### Annealed

| | |
|---|---|
| Hardness (HB) | max. 280 \| drawn execution max. 300 HB |
| Tensile Strength (MPa \| ksi) | max. 1,020 \| 148 |

## Heat treatment

### Annealing

| | | |
|---|---|---|
| Temperature | 770 to 840 °C \| 1,418 to 1,544 °F | Slow cooling in furnace. |

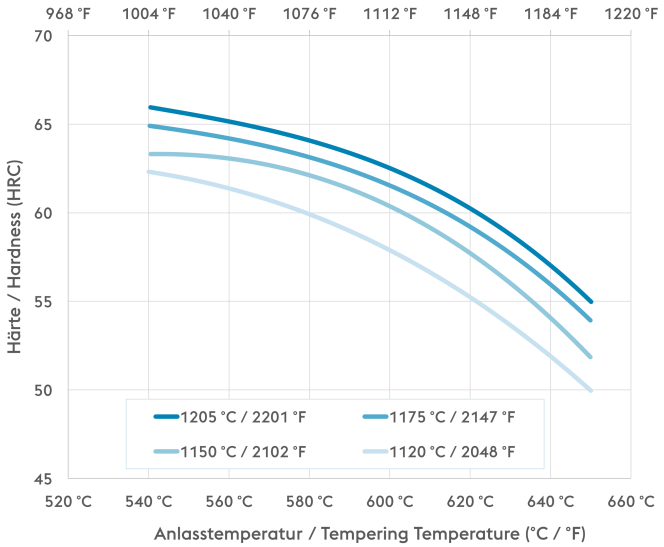
### Stress relieving

| | | |
|---|---|---|
| Temperature | 600 to 650 °C \| 1,112 to 1,202 °F | Slow cooling furnace. \|\| To relieve stresses set up by extensive machining or in tools of intricate shape. \|\| After through heating, hold in neutral atmosphere for 1 to 2 hours. |

### Hardening and Tempering

| | | |
|---|---|---|
| Temperature | 1,100 to 1,200 °C \| 2,012 to 2,192 °F | Salt bath, vacuum \|\| Preheating: 1st stage ~ 500 °C (930 °F), 2nd stage ~ 850 °C (1560 °F), 3rd stage ~1050 °C (1920 °F) \|\| Austenitising: 1100 - 1200 °C (2010 °F - 2230 °F), holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating. \|\|Quenching: oil, warm bath (500 - 550 °C (930 °F - 1020 °F)), gas |
| Temperature | 540 to 570 °C \| 1,004 to 1,058 °F | Slow heating to tempering temperature immediately after austenitising. \|\| Holding time in the furnace 1 hour per 20 mm material thickness (at least 1 hour) \|\| Slow cooling to room temperature between each tempering step \|\| 3 tempering cycles recommended \|\| Hardness see tempering chart |

## Tempering Chart




Holding time 3 x 2 hours
Specimen size: square 25 mm

## Tempering Chart

## Physical Properties

| Temperature (°C \| °F) | 20 \| 68 |
|---|---|
| Density (kg/dm$^3$ \| lb/in$^3$) | 8.1 \| 0.29 |
| Thermal conductivity (W/(m.K) \| BTU/ft h °F) | 20 \| 11.56 |
| 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) | 0.53 \| 2.5 |
| Modulus of elasticity ($10^3$N/mm$^2$ \| $10^3$ksi) | 217 \| 31.47 |

## 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) | 11.5 \| 6.4 | 11.7 \| 6.5 | 12.2 \| 6.8 | 12.4 \| 6.9 | 12.7 \| 7.1 | 13 \| 7.2 | 12.9 \| 7.2 |

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

**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.

*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.*

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ONE STEP AHEAD.