# HIGH SPEED STEELS

## Available Product Shapes

Long Products

## Product Description

**BÖHLER S401 – "The conventional"**
This class comes from the family of molybdenum-alloyed high-speed steels and its winning performance is matched by its good cost effectiveness.

## Properties

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

## Applications

- Twist Drills and Taps
- Thread rolling
- Broaches and Reamers

## Technical data

| Material designation | |
|---|---|
| 1.3346 | SEL |
| M1 | AISI |
| HS2-9-1 | EN |

| Standards | |
|---|---|
| A600 | ASTM |

## Chemical composition (wt. %)

| C | Si | Mn | Cr | Mo | V | W |
|---|---|---|---|---|---|---|
| 0.84 | 0.4 | 0.3 | 3.8 | 8.6 | 1.2 | 1.8 |

## Material characteristics

| | Compressive strength | Grindability | Red hardness | Toughness | Wear resistance | Edge Stability |
|---|---|---|---|---|---|---|
| BÖHLER S401 | ★★ | ★★★ | ★★ | ★★★ | ★★ | ★★★ |
| BÖHLER S200 | ★★★ | ★★ | ★★★ | ★★ | ★★★ | ★★ |
| BÖHLER S290 MICROCLEAN | ★★★★★ | ★ | ★★★★ | ★★ | ★★★★★ | ★★★★ |
| BÖHLER S390 MICROCLEAN | ★★★★ | ★★★ | ★★★★ | ★★★★ | ★★★★ | ★★★★ |
| BÖHLER S400 | ★★★ | ★★★ | ★★★ | ★★★ | ★★ | ★★ |
| BÖHLER S404 | ★★ | ★★★ | ★★ | ★★★ | ★★ | ★★ |
| BÖHLER S500 | ★★★★ | ★★★ | ★★★★ | ★★ | ★★★ | ★★★ |
| BÖHLER S590 MICROCLEAN | ★★★★ | ★★★ | ★★★★ | ★★★ | ★★★ | ★★★ |
| BÖHLER S600 | ★★★ | ★★★ | ★★★ | ★★ | ★★ | ★★★ |
| BÖHLER S607 | ★★★ | ★★★ | ★★★ | ★★ | ★★★ | ★★★ |
| BÖHLER S690 MICROCLEAN | ★★★ | ★★★ | ★★ | ★★★★★ | ★★★ | ★★ |
| BÖHLER S705 | ★★★ | ★★★ | ★★★★ | ★★ | ★★ | ★★★★ |
| BÖHLER S790 MICROCLEAN | ★★★ | ★★★ | ★★ | ★★★★ | ★★ | ★★★ |

## Delivery condition

### Annealed

| | |
|---|---|
| Hardness | max. 280 HB |

## Heat treatment

### Annealing

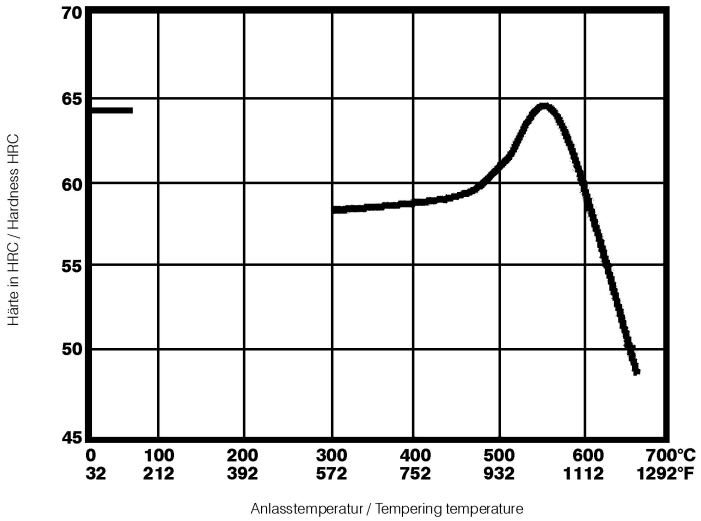
| | | |
|---|---|---|
| Temperature (°C \| °F) | 770 \| 1418 to 840 \| 1544 | Controlled slow cooling in furnace (10 - 20°C / h (50 - 68°F / h) to approx. 600°C (1110°F), air cooling. |

### Stress relieving

| | | |
|---|---|---|
| Temperature (°C \| °F) | 600 \| 1112 to 650 \| 1202 | 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 (°C \| °F) | 1170 \| 2138 to 1210 \| 2210 | Oil, air, salt bath (500 - 550°C (930 - 1020°F), gas. |




## Physical Properties

| Temperature (°C \| °F) | 20 \| 68 |
|---|---|
| Density (kg/dm$^3$ \| lb/in$^3$) | 8 \| 0.29 |
| Thermal conductivity (W/(m.K) \| BTU (IT) ft/hr/ft$^2$/F) | 19 \| 10.98 |
| Specific heat (J/(kg.K) \| BTU (IT) lb/F) | 460 \| 109.87 |
| Spec. electrical resistance (Ohm.mm$^2$/m \| 10$^{-4}$ Ohm.inch$^2$/ft) | 0.6 \| 2.84 |
| Modulus of elasticity (10$^3$N/mm$^2$ \| 10$^3$ksi) | 217 \| 31.47 |

## Thermal Expansions

| Temperature (°C \| °F) | 100 \| 212 | 200 \| 392 | 300 \| 572 | 400 \| 752 | 500 \| 932 | 600 \| 1112 | 700 \| 1292 |
|---|---|---|---|---|---|---|---|
| Thermal expansion ($10^{-6}$ m/(m.K) \| $10^{-6}$ inch/(inch.F)) | 11 \| 6.111 | 11.5 \| 6.389 | 11.9 \| 6.611 | 12.3 \| 6.833 | 12.4 \| 6.889 | 12.5 \| 6.944 | 12.5 \| 6.944 |

For more information see www.voestalpine.com/bohler-edelstahl



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ONE STEP AHEAD.