BÖHLER

HIGH SPEED
STEEL

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BÖHLER S630

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

voestalpine
ONE STEP AHEAD.

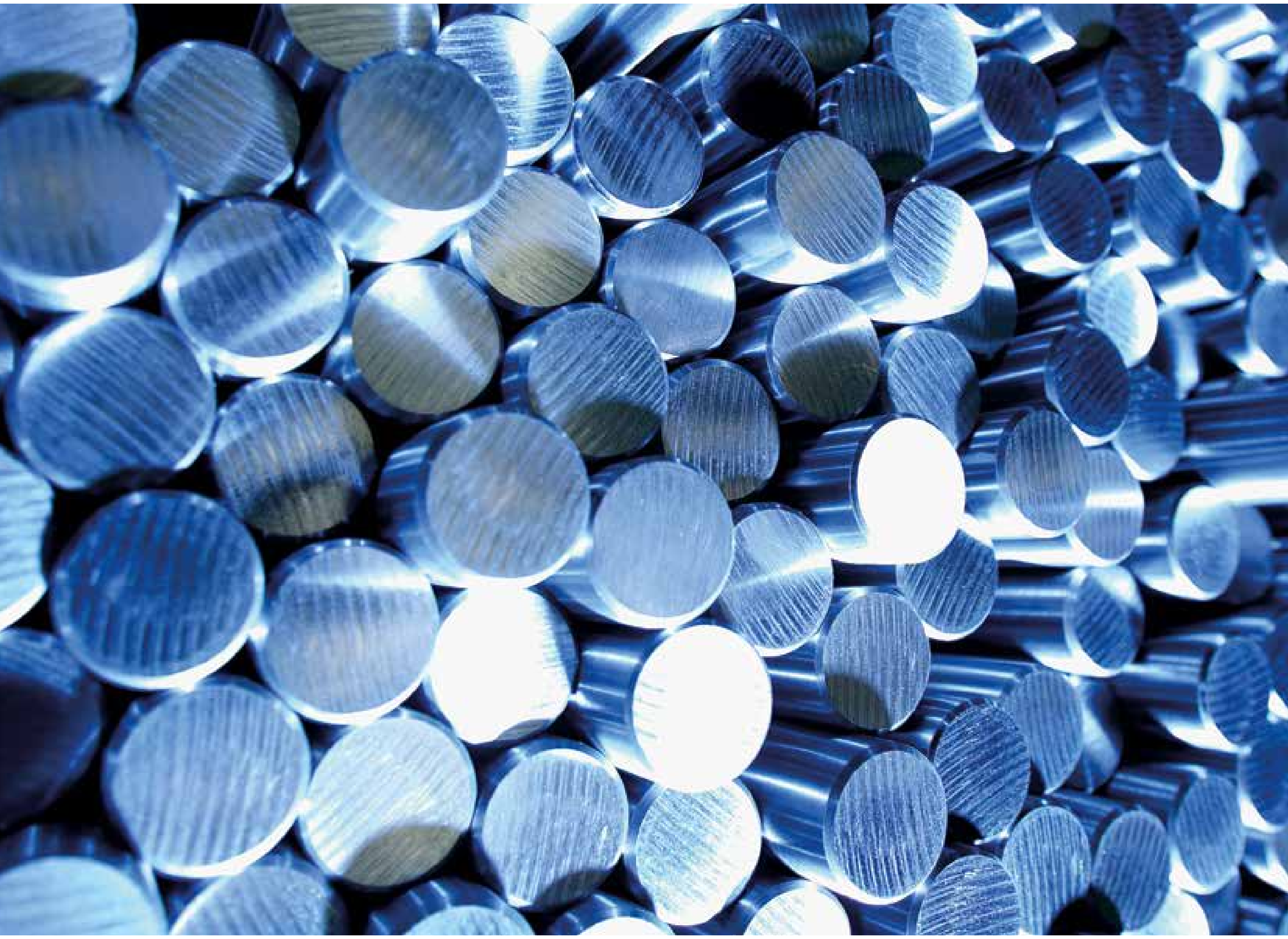
THE SAME PERFORMANCE IMPROVED EFFICIENCY

BÖHLER S630
the economical high-speed steel

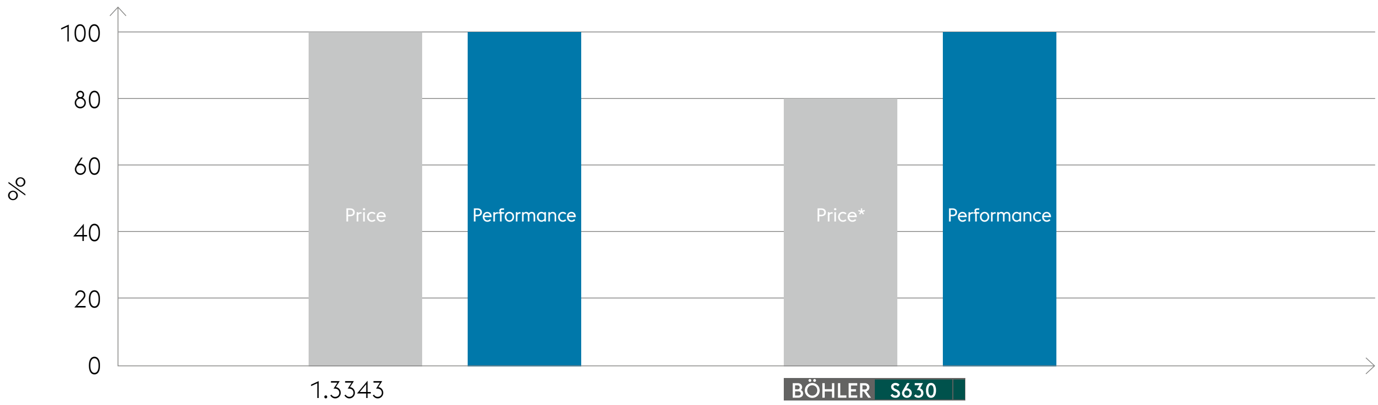
HIGH SPEED STEEL

The price of high-speed steels is significantly influenced by used aloying elements. Due to the situation on the com-modities market and the ever-rising costs for molybdenum, chromium, tungsten, vanadium, cobalt and scrap voestalpine BÖHLER Edelstahl has developed a HSS material that shows improved efficiency with the same performance compared to the generally applicable standard brand 1.3343, ≈ M2 (S600).The only possibility of achieving this goal is found in the composition of the analysis.

BÖHLER Grade		Chemical composition (average %)					
		C	Al	Cr	Mo	V	W
BÖHLER S600	1.3343	0.89	0.00	4.10	5.00	1.80	6.20
BÖHLER S630	1.3330	0.95	0.50	4.00	4.00	2.00	4.00

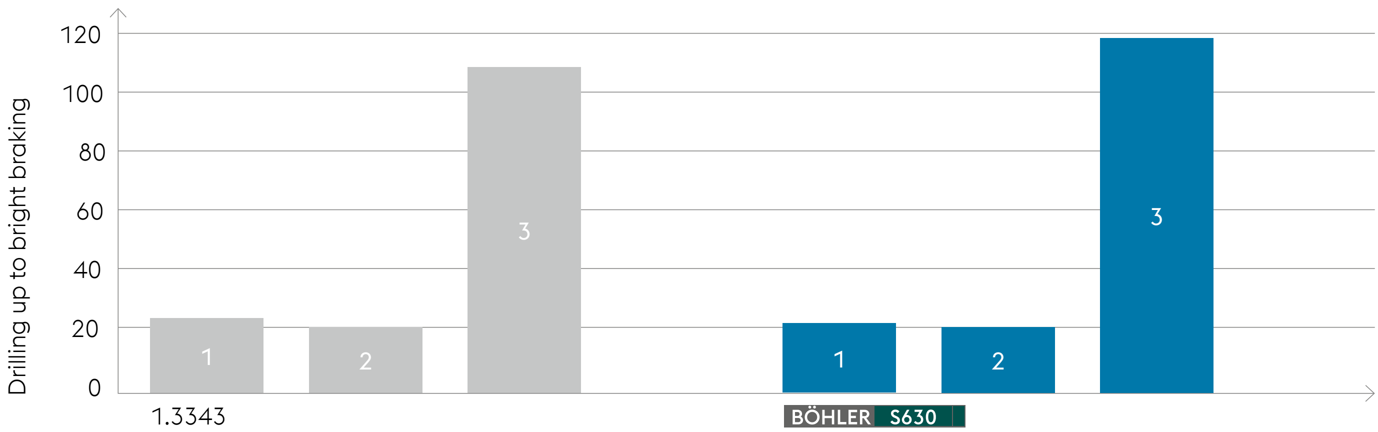


Comparison price-performance ratio



*Price depend on the current alloy prices.

Drilling examinations (international manufacturers of drills, dia. 8.5 mm drill, uncoated)



1 high cutting data v = 20 m/min., f/U = 0.24 mm
2 median cutting data v = 25 m/min., f/U = 0,16 mm
3 normal cutting data v = 12 m/min., f/U = 0,10 mm

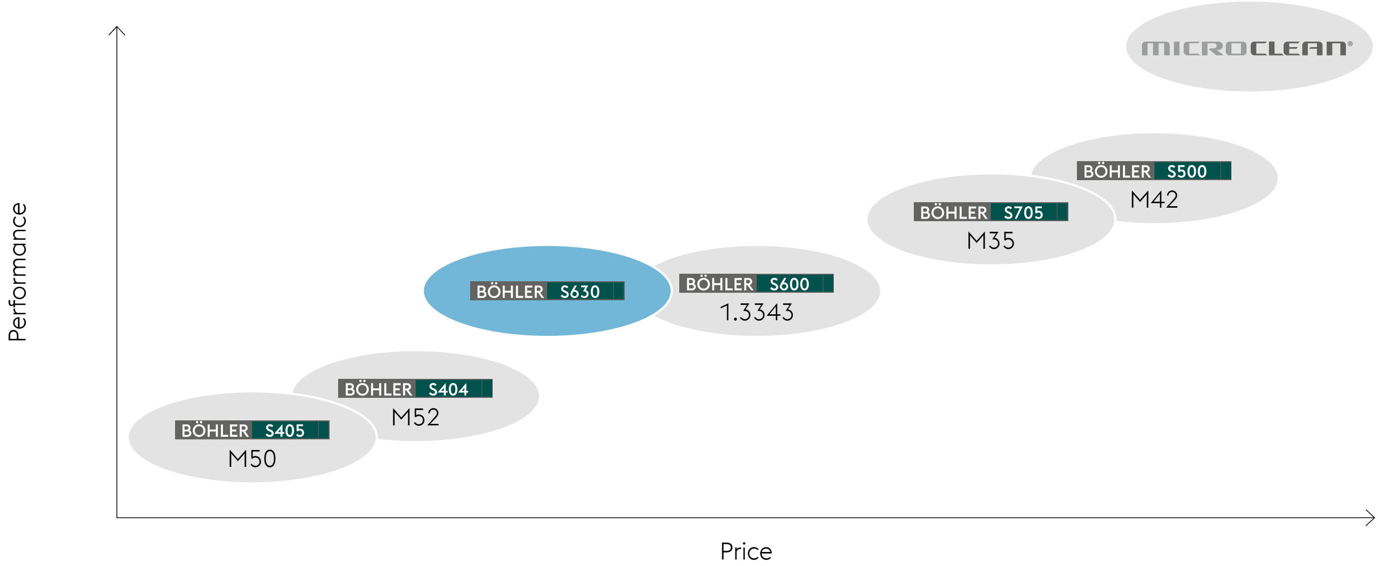
WHY ALUMINIUM?

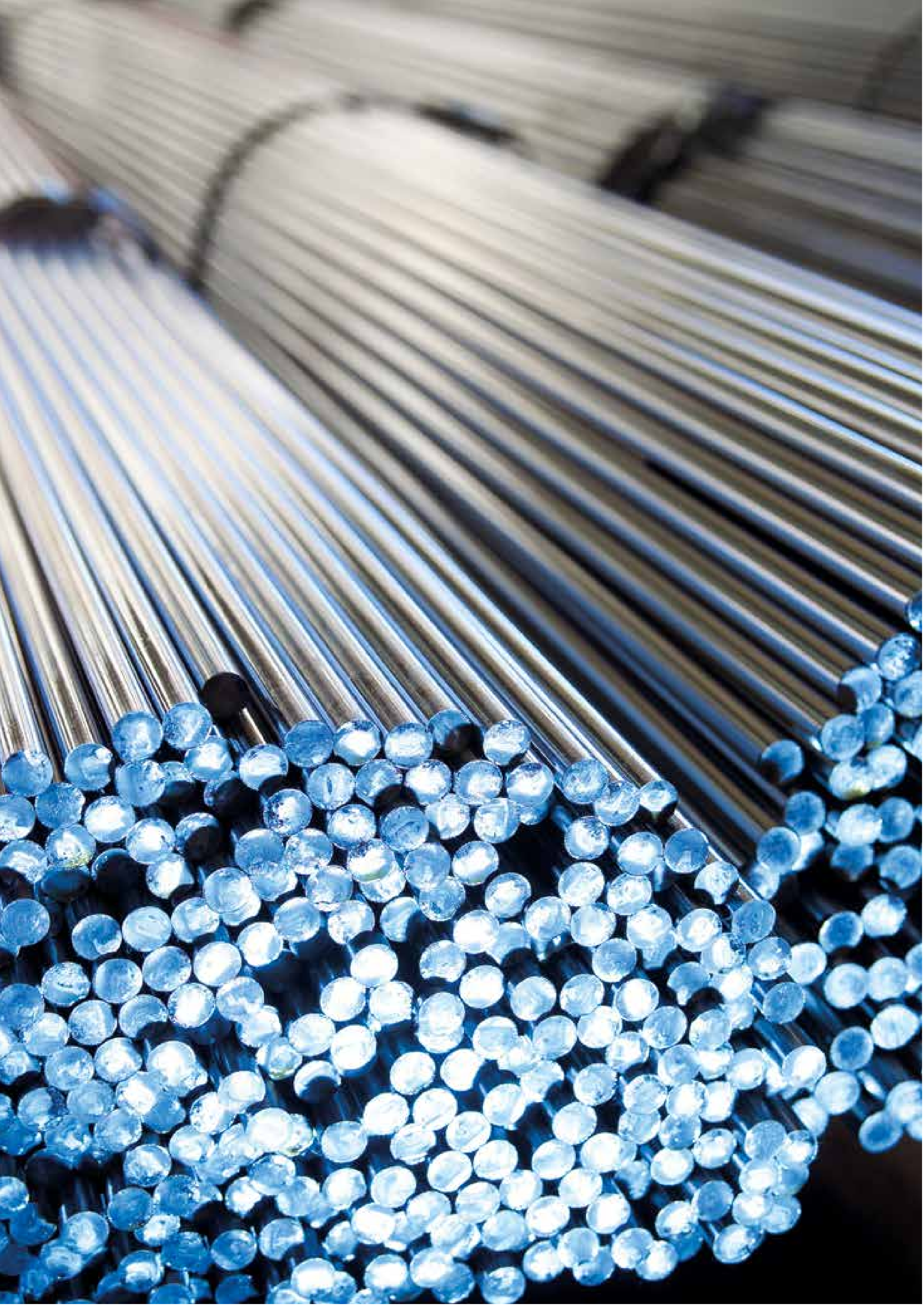
Aluminium as a supplementary alloy in high-speed steel brings about an increase in both the abrasive and the adhesive wear resistance with optimum hardness and toughness values.

That means that aluminium promotes the formation of more wear resistant carbides/nitrides in the structures and, with a typical surface treatment such as oxidizing or nitriding, leads to relatively more favorable friction values and a reduction in friction coefficients when machining.

BÖHLER S630 uses the alloying element aluminium with an overall lower alloy content to obtain the same properties as with the standard high-speed steel 1.3343.

Price-performance chart





COMPARISON OF THE MAJOR STEEL PROPERTIES

BÖHLER Grade	Red hardness	Wear resistance	Toughness	Grindability	Compressive strength
BÖHLER S200	★★★	★★★	★★	★★	★★★
BÖHLER S400	★★★	★★	★★★	★★★	★★★
BÖHLER S401	★★	★★	★★★	★★★	★★
BÖHLER S404	★★	★★	★★★	★★★	★★
BÖHLER S500	★★★★	★★	★★	★★★	★★★★
BÖHLER S600	★★★	★★	★★★	★★★	★★★
BÖHLER S630	★★★	★★	★★★	★★★	★★★
BÖHLER S700	★★★	★★★★	★★	★★	★★★★
BÖHLER S705	★★★	★★	★★★	★★★	★★★
BÖHLER S730	★★★	★★	★★★	★★★	★★★
BÖHLER S290 MICROCLEAN®	★★★★★	★★★★★	★	★	★★★★★
BÖHLER S390 MICROCLEAN®	★★★★	★★★★	★★★★	★★★	★★★★
BÖHLER S590 MICROCLEAN®	★★★★	★★★	★★★	★★★	★★★★
BÖHLER S690 MICROCLEAN®	★★	★★★	★★★★★	★★★	★★★
BÖHLER S790 MICROCLEAN®	★★	★★	★★★★	★★★	★★★

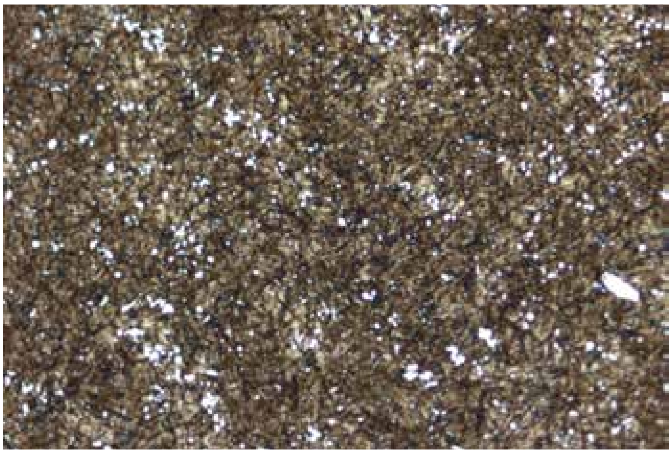
This table is intended to facilitate the steel choice.
It does not, however, take into account the various stress conditions imposed by the different types of application.
Our technical consultancy staff will be glad to assist you in any questions concerning the use and processing of steels.

BEST
PROPERTIES

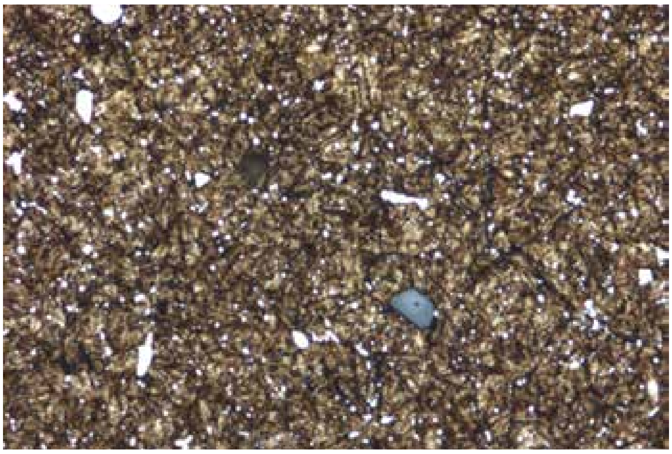
Properties
Tungsten-molybdenum high speed steel with aluminium alloy with excellent toughness and cutting properties, for a wide variety of uses.

Applications
Taps, twist drills, reamers, broaching tools, metal saws, milling tools of all types, woodworking tools, punches and other cold work applications.

Structure (salt bath TA = 1200 °C (2192 °F), TT = 560 °C (1040 °F) / 3 x 2 h)



1.3343
Hardness: 65,9 HRc



BÖHLER S630
Hardness: 66 HRc

HEAT TREATMENT

Hot forming

Forging
1100 to 900 °C (2012 to 1652 °F)
Slow cooling in furnace or in thermoinsulating material.

Heat treatment

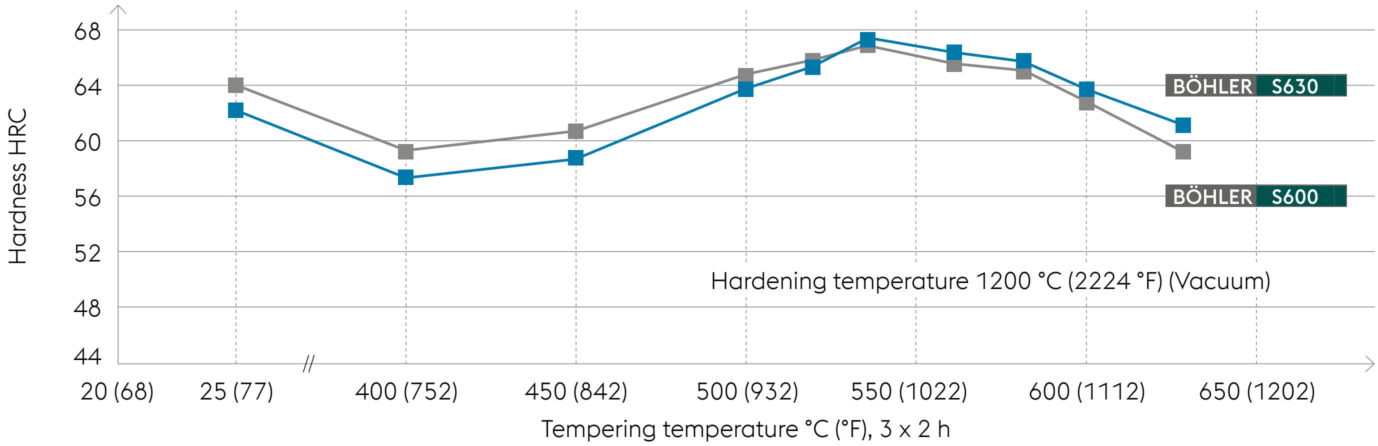
Annealing
770 to 840 °C (1418 to 1544 °F) / Controlled slow cooling in furnace (10 to 20 °C/h / (50 to 68 °F/h) to approx. 600 °C (1110 °F), air cooling.
Hardness after annealing:
max. 280 Brinell.

Stress relieving
600 to 650 °C (1112 to 1202 °F)
Slow cooling in furnace.
To relieve stresses set up by extensive machining or in tools of intricate shape. After through heating, maintain a neutral atmosphere for 1-2 hours.

Hardening
1180 to 1200 °C (2174 to 2246 °F)
Oil, air, salt bath (500 to 550 °C / 932 to 1022 °F), gas.
Upper temperature range for parts of simple shape, lower for parts of complex shape. For coldworking tools also lower temperatures are of importance for higher toughness. A minimum of 80 seconds soaking time after heating the whole section of a work-piece is required for dissolving sufficient carbides with a maximum soaking time of 150 seconds to avoid damages by oversoaking. In practice instead of soaking time, the time of exposure from placing the workpiece into the salt bath after preheating until its removal (including the stages of heating to the speci-fied surface temperature and of heating to the temperature throughout the whole section) is used (see immersion time diagrams).
Vacuum hardening is also possible. The time in the vacuum furnace depends on the relevant workpiece size and furnace parameters.

HEAT TREATMENT

Hardness-annealing properties in comparison

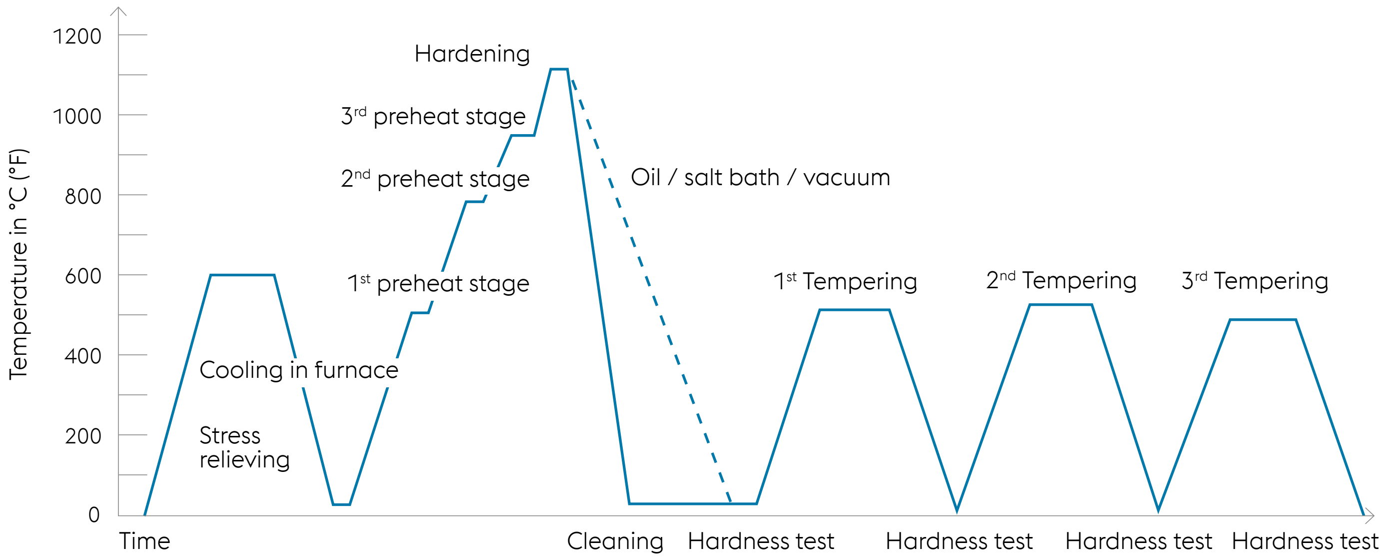


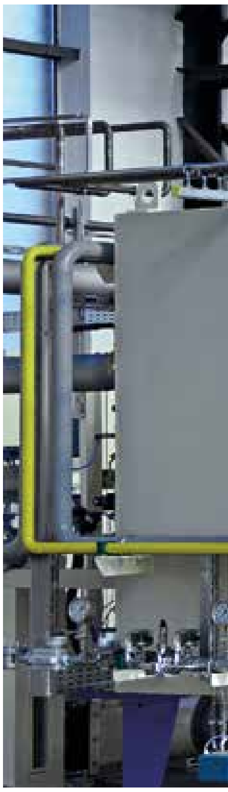
Surface treatment

Nitriding

Parts made from this steel can be plasma, bath and gas nitrided.

Heat treatment sequence

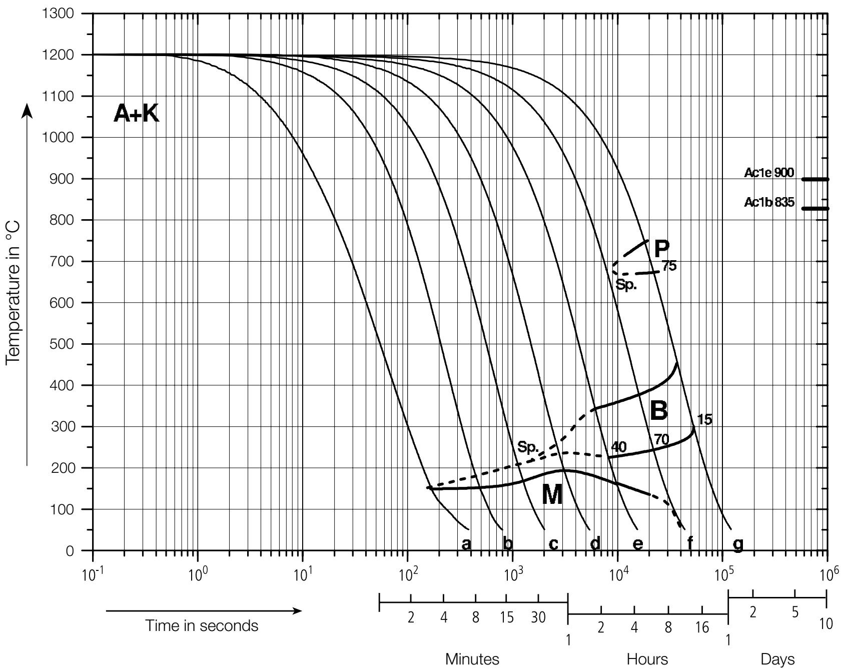




HEAT TREATMENT RECOMMENDATION

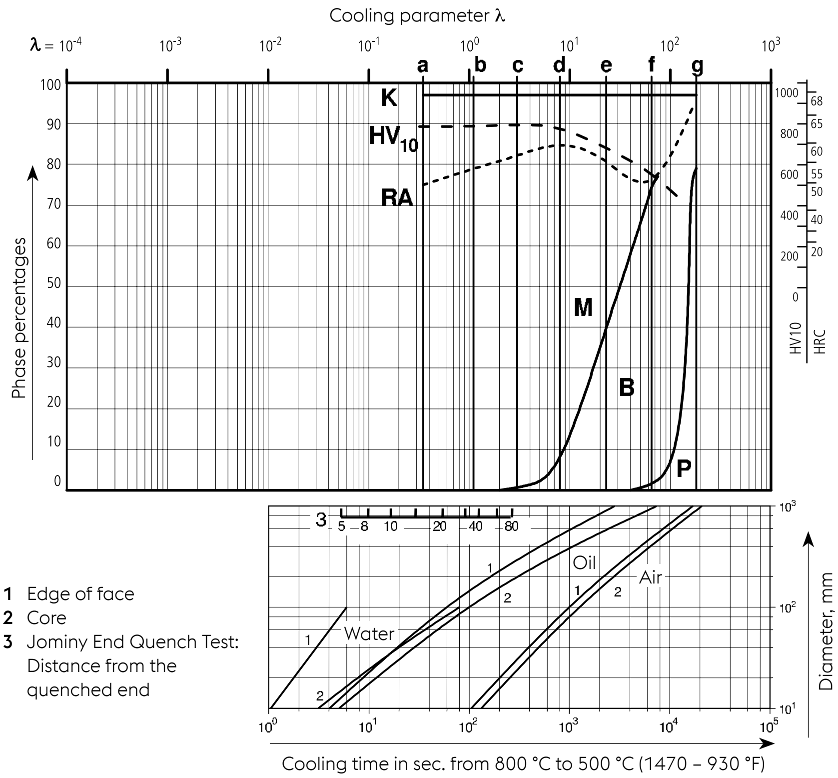
Continuous cooling CCT curves

Austenitizing temperature	1210 °C (2210 °F)
Holding time	150 seconds
Vickers hardness	
1	30 phase percentages
0.39	23.5 cooling parameter, i.e. duration of cooling from 800 – 500 °C (1472 – 932 °F) in s x 10^{-2}
2 K/min	0.5 K/min cooling rate in K/min in the 800 – 500 °C (1472 – 932 °F) range
Ms-Ms’	range of grain boundary martensite formation



Quantitative phase diagram

A	Austenite
B	Bainite
K	Carbide
M	Martensite
P	Perlite
Lk	Ledeburite carbide
RA	Retained austenite



Analysis	C	Si	Mn	P	Co	S	Cr	Mo	Ni	V	W	Al	Cu
BÖHLER S630	0.97	0.40	0.34	0.023	0.36	0.0004	4.32	4.00	0.29	1.94	3.96	0.55	0.14

S630
AT A GLANCE

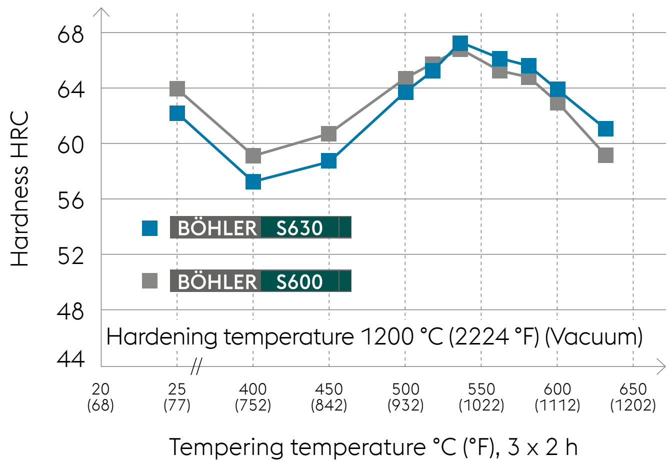
Physical properties

	at 20 °C	at 68 °F
Density	7,88 kg/dm³	0.28 lbs/in³
Thermal conductivity	18,8 W/(m.K)	10.86 Btu/ft h °F
Specific heat	432 J/(m.K)	0.103 Btu/lb °F
Electrical resistivity	0,56 Ohm mm²/m	0,56 Ohm mm²/m
Modulus of elasticity	217* 10³ N/mm²	31.5* 10⁶ psi

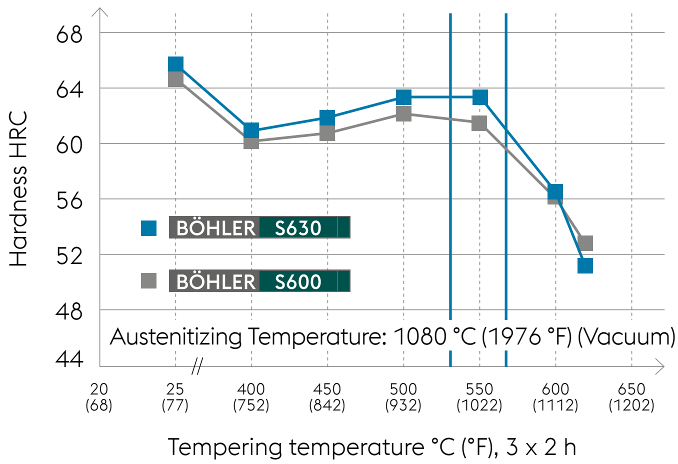
In each individual case with regards to applications and processing steps that are not expressly mentioned in this product description/ data sheet, the customer is required to consult us.

BÖHLER Grade		Chemical composition (average %)					
		C	Al	Cr	Mo	V	W
BÖHLER S630	1.3330	0.95	0.50	4.00	4.00	2.00	4.00

Hardness-annealing properties for cutting applications



Hardness-annealing properties for cold work applications



1932

initial in-house tests at BÖHLER Kapfenberg conducted on the effects of aluminium in high speed steels containing tungsten.

1936

Three Component Steel (Dreierstahl) HS 3-3-2 is patented by BÖHLER Kapfenberg.

1938 - 1944

The Three Component Steel (Dreierstahl) was introduced during World War II in the wake of the critical scarcity of resources (particularly tungsten). Due to its relatively good cutting performance, the Three Component Steel (Dreierstahl) was at that time the most widely used and reliable high speed steel and for years made up a great deal of German high speed steel production.

1940 - 1944

Due to the scarcity of accessible tungsten and the small number of tungsten deposits in and around Austria-Germany, dissertation work began at the Montan University in Leoben on how to replace tungsten in the Three Component Steel (Dreierstahl), partially or completely, with more reasonably priced alloy elements. Tests showed that the effects desires would be able to be obtained by using the alloy element aluminium.Based on the results at that time the Upper Silesian iron and steel works produced a high speed steel, marketed as „Alcor“ in which the tungsten content of the Three Component Steel (Dreierstahl) had been completely replaced by aluminium. That steel is to have had the same cutting performance as the Three Component Steel (Dreierstahl) HS 3-3-2.

HIGH SPEED STEELS CONTAINING ALUMINIUM

about. 1945 - 1986

There were nearly no tests conducted on the effects of aluminium on high speed steels, perhaps due to the relatively high availability of the raw material and the fact that cutting back on it was essentially not necessary.

from about 1986

Several tests conducted in China confirm the positive effects of aluminium in high speed steels (better machining qualities, a longer service life). The goal the Chinese set was to replace cobalt with aluminium. Cobalt is very rare in China and has to be imported.

1988-1991

BÖHLER S620 (HS 6-5-2 + Al) is developed. S620 features a cutting performance similar to S705 (HS 6-5-2-5).

about 2005 -2008

Enormous increase in the costs of alloying elements, particularly of tungsten and molybdenum. BÖHLER reacts to this increase by developing S419 containing aluminium (HS 2-2.5-1 +Al) as the more affordable alter-native to S404 (HS 1-4-2). The drilling capacity is comparable.

about 2007 - 2010

Based on the results previously mentioned the S630 (HS 4-4-2 +Al) containing aluminium was developed for the higher alloyed S600 (HS 6-5-2). Drilling tests conducted by customers and by BÖHLER in-house con-firm the comparable cutting performance of S630.

2009 - 2013

BÖHLER dissertations applying the most modern research methods have been done at the Montan University in Leoben on the subject of a physical metallurgy clarification of the positive effects of aluminium in high speed steels.

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