# VANADIS® 30 SuperClean[3]

**Powder metallurgical cold work tool steel**

**COLD** WORK | **PLASTIC** MOULDING | **HOT** WORK | **HIGH** PERFORMANCE STEEL

UDDEHOLM

# Applications

Vanadis 30 is a cobalt alloyed high performance PM high speed steel. The cobalt addition of approx. 8,5% has a positive influence on the hot strength/hot hardness, temper resistance and modulus of elasticity. The presence of cobalt has little influence on wear resistance. As cobalt does not form carbides, the wear resistance of Vanadis 30 is more or less the same as for steels with the same base analysis but without cobalt (e.g. Vanadis 23). On the other hand, its presence reduces the toughness and hardenability somewhat but increases compressive strength and high temperature properties.

### FOR COLD WORK

- The combination of high wear resistance and unusually good compressive strength can be put to use in tooling for heavy forming operations.
- In some cold work operations, the active surface (e.g. cutting edge or forming surface) of a tool can reach temperatures in excess of 200°C (390°F). Such conditions can be found in tooling running on high speed presses. Also, development of high temperatures in the tooling can be expected in heavy forming operations.

# General

Vanadis 30 is a W-Mo-V-Co alloyed PM high speed steel characterized by:

- High wear resistance
- High compressive strength at high hardness
- Good through hardening properties
- Good toughness
- Good dimensional stability on heat treatment
- Good grindability and machinability
- Very good temper resistance.

| Typical analysis % | C<br>1,28 | Cr<br>4,2 | Mo<br>5,0 | W<br>6,4 | V<br>3,1 | Co<br>8,5 |
|---|---|---|---|---|---|---|
| Standard specification | (W.-Nr. 1.3207) AISI M2+Co | | | | | |
| Delivery condition | Soft annealed, max. 300 HB<br>Drawn, max. 320 HB | | | | | |
| Colour code | Dark green | | | | | |

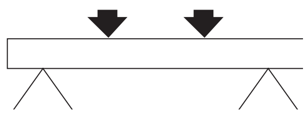
# Properties

### PHYSICAL DATA

| Temperature | 20°C<br>(68°F) | 400°C<br>(750°F) | 600°C<br>(1112°F) |
|---|---|---|---|
| Density, kg/m³ (1)<br>lbs/in³ (1) | 8040<br>0,287 | 7935<br>0,285 | 7880<br>0,284 |
| Modulus of elasticity<br>MPa (2)<br>ksi (2) | <br>240 000<br>34 x $10^3$ | <br>214 000<br>31 x $10^3$ | <br>192 000<br>28 x $10^3$ |
| Coefficient of thermal expansion per<br>°C from 20°C (2)<br>°F from 68°F (2) | <br>–<br>– | <br>11,8 x $10^{-6}$<br>6,5 x $10^{-6}$ | <br>12,3 x $10^{-6}$<br>6,8 x $10^{-6}$ |
| Thermal conductivity<br>W/m•°C (2)<br>Btu in/(ft² h°F) (2) | <br>22<br>152 | <br>26<br>180 | <br>25<br>173 |
| Specific heat<br>J/kg °C (2)<br>Btu/lb °F (2) | <br>420<br>0,10 | <br>510<br>0,12 | <br>600<br>0,14 |

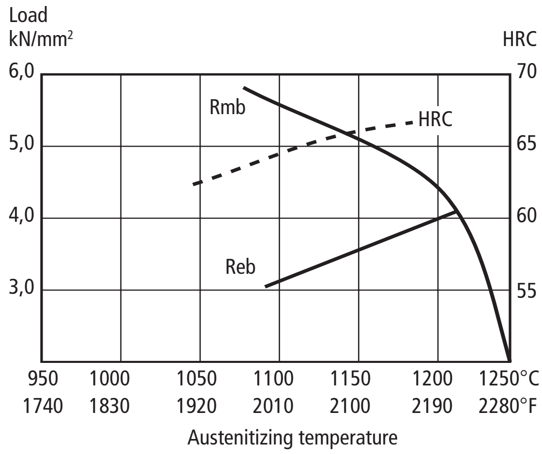
(1) = for the soft annealed condition.
(2) = for the hardened and tempered condition.

### BEND STRENGTH AND DEFLECTION



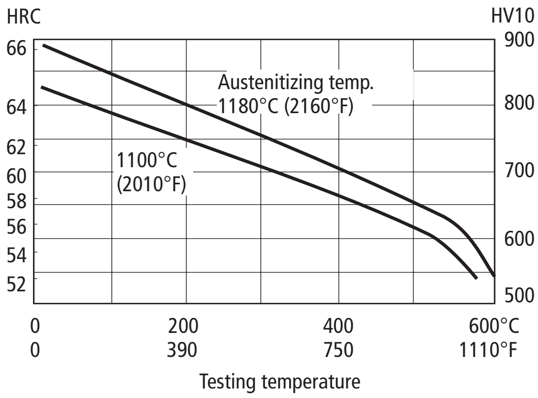
Four-point bend testing.
*Specimen size:* 5 mm (0,2") Ø.
*Loading rate:* 5 mm/min (0,2"/min.).
*Austenitizing temperature:* 1050–1180°C (1920–2160°F).
*Tempering:* 3 x 1 h at 560°C (1040°F), air cooling to room temperature.

*Punches for high performance.*
*A suitable application for Vanadis 30.*



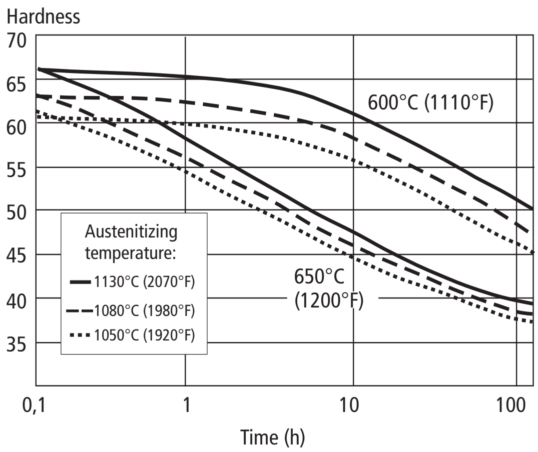

### HIGH TEMPERATURE PROPERTIES

*Vanadis 30 hot hardness*




*Change in hardness versus holding time for different working temperatures*

Austenitizing temperature: 1050–1130°C (1920–2070°F).
Tempering: 3 x 1 h at 560°C (1040F).




# Heat treatment

### SOFT ANNEALING

Protect the steel and heat through to 850–900°C (1560–1650°F). Then cool in the furnace at 10°C/h (20°F/h) to 700°C (1290°F), then freely in air.

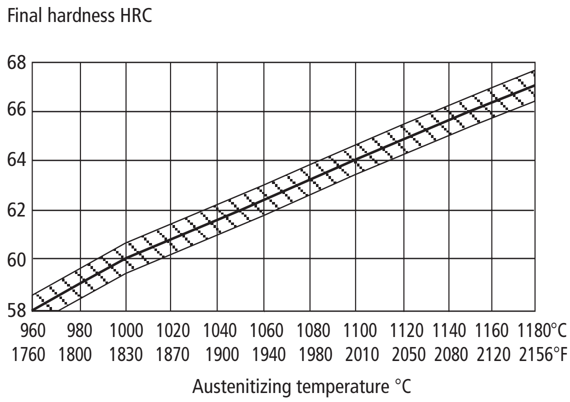
### STRESS RELIEVING

After rough machining the tool should be heated through to 600–700°C (1110–1290°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

### HARDENING

*Pre-heating temperature:* 450–500°C (840–930°F) and 850–900°C (1560–1650°F).
*Austenitizing temperature:* 1050–1180°C (1920–2160°F), according to the desired final hardness, see diagram below.
The tool should be protected against decarburization and oxidation during hardening.

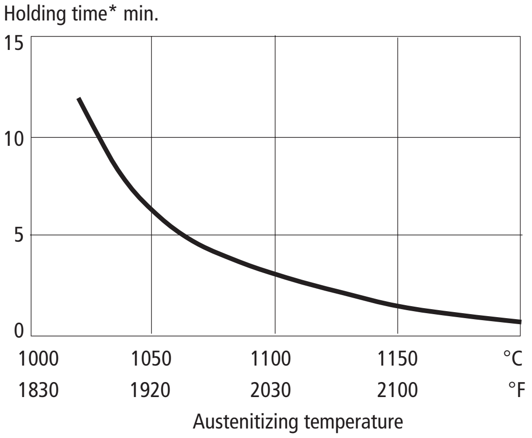
*Hardness after tempering 3 times for one hour at 560°C (1040°F)*




*Hardness for different austenitizing temperatures after tempering 3 times for one hour at 560°C (±1 HRC)*

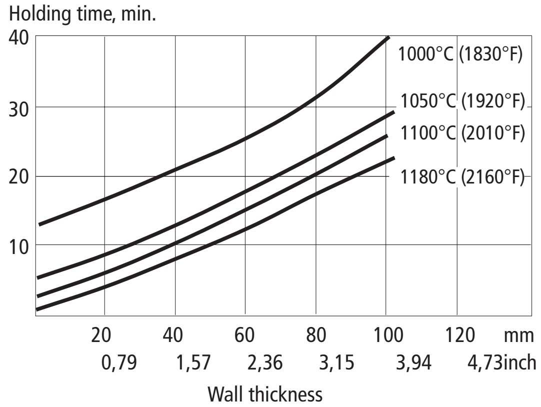
| HRC | °C | °F |
|---|---|---|
| 60 | 1000 | 1832 |
| 62 | 1050 | 1922 |
| 64 | 1100 | 2012 |
| 66 | 1150 | 2102 |
| 67 | 1180 | 2156 |

*Recommended holding time*



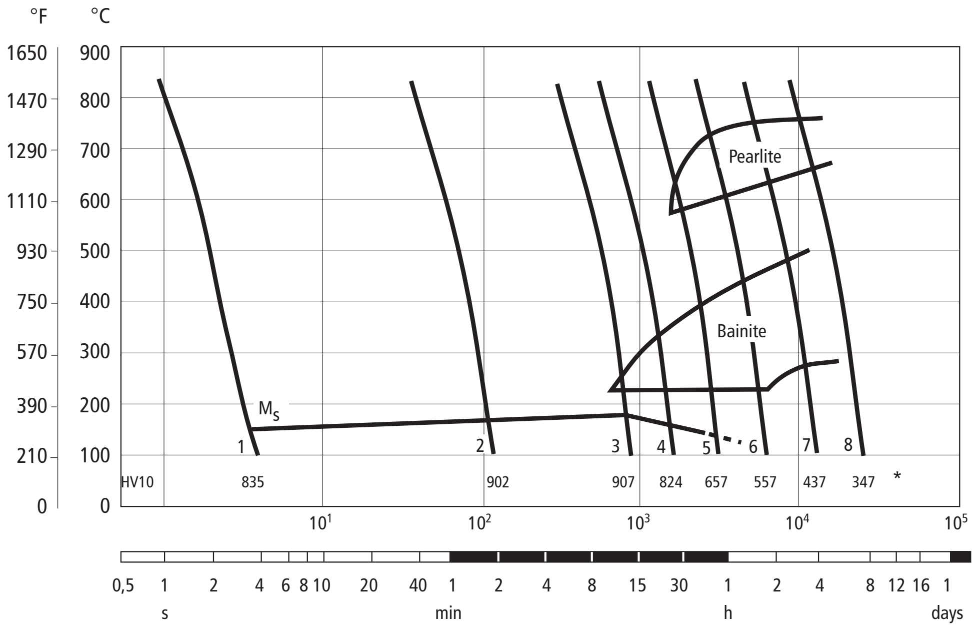

** Holding time = time at austenitizing temperature after the tool is fully heated through.*

*Total soaking time in a salt bath after pre-heating in two stages at 450°C (840°F) and 850°C (1560°F)*




*CCT-graph (continuous cooling)*

Austenitizing temperature 1180°C (2160°F).



### QUENCHING MEDIA

- Martempering bath at approx. 540°C (1004°F)
- Vacuum furnace with high speed gas at sufficient overpressure.

*Note. 1:* Quenching should be continued until the temperature of the tool reaches approx. 50°C (122°F). The tool should then be tempered immediately.

*Note. 2:* In order to obtain a high toughness, the cooling speed in the core should be at least 10°C/sec. (20°F/sec.). This is valid for cooling from the austenitizing temperature down to approx. 540°C (1004°F). After temperature equalization between the surface and core, the cooling rate of approx. 5°C/sec. (10°F/sec.) can be used. The above cooling cycle results in less distortion and residual stresses.

### TEMPERING

Tempering should always be carried out at 560°C (1040°F) irrespective of the austenitizing temperature. Temper three times for one hour at full temperature. The tool should be cooled to room temperature between the tempers. The retained austenite content will be less than 1% after this tempering cycle.

### DIMENSIONAL CHANGES

Dimensional changes after hardening and tempering.
*Heat treatment:* austenitizing between 1050–1140°C (1920–2080°F) and tempering 3 x 1h at 560°C (1040°F).
*Specimen size:* 80 x 80 x 80 mm (2,91 x 2,91 x 2,91 in.) and 100 x 100 x 25 mm (3,94 x 3,94 x 0,99 in.).
*Dimensional changes:* growth in length, width and thickness: +0,03% to +0,13%.

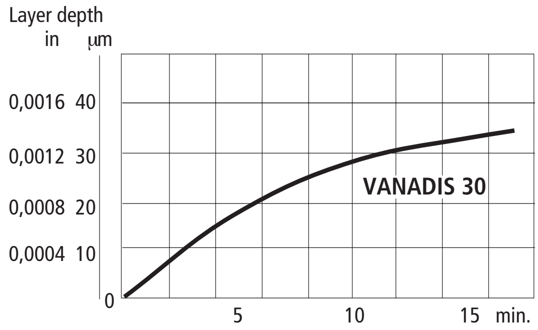
## Surface treatments

Some tools are given a surface treatment in order to reduce friction and increase tool wear resistance. The most commonly used treatments are nitriding and surface coating with wear resistant layers of titanium carbide and titanium nitride (CVD, PVD).

Vanadis 30 has been found to be particularly suitable for titanium carbide and titanium nitride coatings. The uniform carbide distribution in Vanadis 30 facilitates bonding of the coating and reduces the spread of dimensional changes resulting from hardening. This, together with its high strength and toughness, makes Vanadis 30 an ideal substrate for high-wear surface coatings.

### NITRIDING

A brief immersion in a special salt bath to produce a nitrided diffusion zone of 2–20 µm is recommended. This reduces friction on the envelope surface of punches and has various other advantages.




Depth of nitriding layer
after nitrocarburizing at 570°C (1060°F)

### PVD

Physical vapour deposition, PVD, is a method of applying a wear-resistant coating at temperatures between 200–500°C (390–930°F). As Vanadis 30 is high temperature tempered at 560°C (1040°F), there is no danger of dimensional changes during PVD coating.

### CVD

Chemical vapour deposition, CVD, is used for applying wear resistant surface coatings at a temperature of around 1000°C (1830°F). It is recommended that the tools should be separately hardened and tempered in a vacuum furnace after surface treatment.

# Cutting data recommendations

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions. More information can be found in the Uddeholm publication "Cutting data recommendations"

### Condition: Soft annealed to approx. 300 HB

## TURNING

| Cutting data parameters | Turning with carbide Rough turning | Turning with carbide Fine turning | Turning with HSS Fine turning |
|---|---|---|---|
| Cutting speed ($v_c$) m/min<br>f.p.m. | 80–110<br>262–361 | 110–140<br>361–459 | 10–15<br>33–49 |
| Feed (f) mm/r<br>i.p.r. | 0,2–0,4<br>0,008–0,016 | 0,05–0,2<br>0,002–0,008 | 0,05–0,3<br>0,002–0,012 |
| Depth of cut ($a_p$) mm<br>inch | 2–4<br>0,08–0,16 | 0,5–2<br>0,02–0,08 | 0,5–3<br>0,02–0,12 |
| Carbide designation ISO | K20, P10–P20 Coated carbide* | K15, P10 Coated carbide* | – |

** Use a wear resistant CVD-coated carbide grade*

## DRILLING

### High speed steel twist drill

| Drill diameter mm | Drill diameter inch | Cutting speed $v_c$ m/min. | Cutting speed $v_c$ f.p.m. | Feed f mm/r | Feed f i.p.r. |
|---|---|---|---|---|---|
| – 5 | –3/16 | 8–10* | 27–33* | 0,05–0,15 | 0,002–0,006 |
| 5–10 | 3/16–3/8 | 8–10* | 27–33* | 0,15–0,20 | 0,006–0,008 |
| 10–15 | 3\|8–5\|8 | 8–10* | 27–33* | 0,20–0,25 | 0,008–0,010 |
| 15–20 | 5\|8–3\|4 | 8–10* | 27–33* | 0,25–0,35 | 0,010–0,014 |

*For coated HSS drill $v_c$ = 14–16 m/min. (46–52 f.p.m.)*

### Carbide drill

| Cutting data parameters | Type of drill: Indexable insert | Solid carbide | Brazed carbide[1] |
|---|---|---|---|
| Cutting speed, $v_c$ m/min<br>f.p.m. | 100–130<br>328–435 | 50–70<br>164–230 | 25–35<br>82–115 |
| Feed, f mm/r<br>i.p.r. | 0,05–0,15[2]<br>0,002 –0,006[2] | 0,10–0,25[2]<br>0,004–0,010[2] | 0,15–0,25[2]<br>0,006–0,010[2] |

*[1] Drill with internal cooling channels and brazed tip.*
*[2] Depending on drill diameter.*

## MILLING

### Face and square shoulder milling

| Cutting data parameters | Milling with carbide Rough milling | Milling with carbide Fine milling |
|---|---|---|
| Cutting speed ($v_c$) m/min<br>f.p.m. | 40–80<br>131–265 | 80–110<br>265–361 |
| Feed ($f_z$) mm/tooth<br>inch/tooth | 0,2–0,4<br>0,008–0,016 | 0,1–0,2<br>0,004–0,008 |
| Depth of cut ($a_p$) mm<br>inch | 2–4<br>0,08–0,16 | –2<br>–0,08 |
| Carbide designation ISO | K20–P20 Coated carbide* | K15–P15 Coated carbide* or cermet |

** Use a wear resistant CVD-coated carbide grade*

### End milling

| Cutting data parameters | Type of mill: Solid carbide | Carbide indexable insert | High[2] speed steel |
|---|---|---|---|
| Cutting speed ($v_c$) m/min<br>f.p.m. | 35–45<br>115–150 | 70–90<br>230–300 | 12–16<br>39–52 |
| Feed ($f_z$) mm/tooth<br>inch/tooth | 0,01–0,2[1]<br>0,0004–0,008[1] | 0,06–0,2[1]<br>0,002–0,008[1] | 0,01–0,3[1]<br>0,0004–0,012[1] |
| Carbide designation ISO | – | K15, P10–P20 Coated carbide[3] | – |

*[1] Depending on radial depth of cut and cutter diameter.*
*[2] Uncoated high speed steel mill is not recommeded*
*[3] Use a wear resistant CVD-coated carbide grade*

## GRINDING

General grinding wheel recommendation is given below. More information can be found in the Uddeholm publication "Grinding of Tool Steel".

| Type of grinding | Annealed condition | Hardened condition |
|---|---|---|
| Face grinding straight wheel | A 46 HV | B151 R50 B3[1]<br>A 46 HV[2] |
| Face grinding segments | A 36 GV | A 46 GV |
| Cylindrical grinding | A 60 KV | B151 R50 B3[1]<br>A 60 KV[2] |
| Internal grinding | A 60 JV | B151 R75 B3[1]<br>A 60 IV |
| Profile grinding | A 100 JV | B126 R100 B6[1]<br>A 120 JV[2] |

*[1] If possible use CBN wheels for this application.*
*[2] Preferable a wheel type containing sintered $Al_2O_3$ (seeded gel)*

## EDM

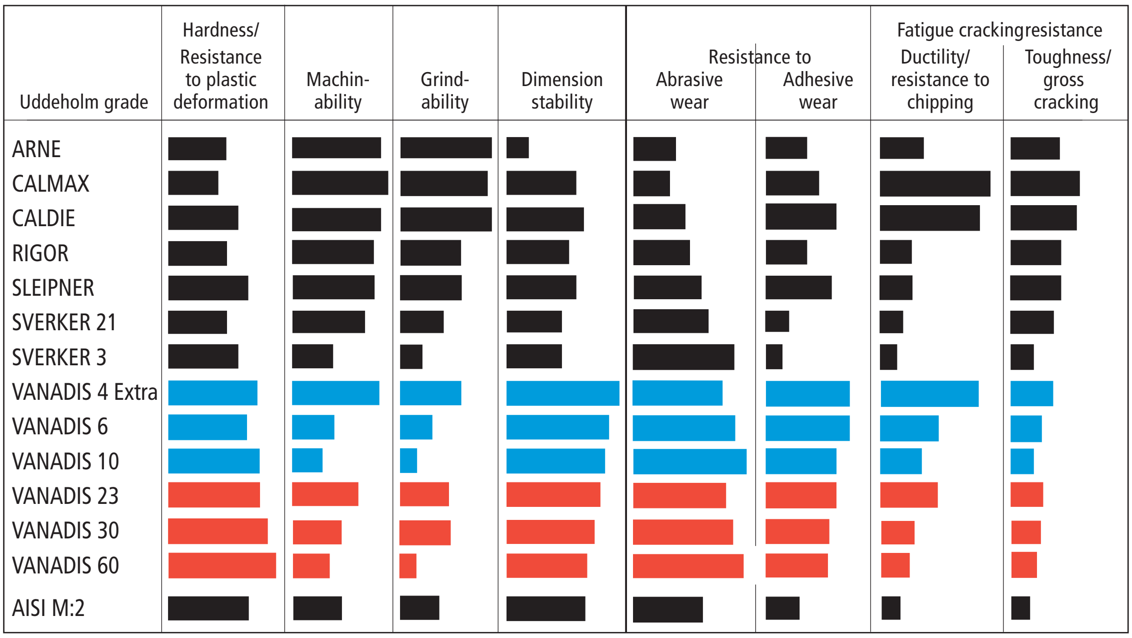
If EDM is performed in the hardened and tempered condition, finish with "finesparking", i.e. low current, high frequency. For optimal performance the EDM'd surface should then be ground/polished and the tool retempered at approx. 535°C (995°F).

## Further information

Please, contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels.

## Relative comparison of Uddeholm cold work tool steels

### MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS



## UDDEHOLM EUROPE

### AUSTRIA
UDDEHOLM
Hansaallee 321
D-40549 Düsseldorf
Telephone: +49 211 535 10
Telefax: +49 211 535 12 80

### BELGIUM
UDDEHOLM N.V.
Waterstraat 4
B-9160 Lokeren
Telephone: +32 9 349 11 00
Telefax: +32 9 349 11 11

### CROATIA
BOHLER UDDEHOLM Zagreb
d.o.o za trgovinu
Zitnjak b.b
10000 Zagreb
Telephone: +385 1 2459 301
Telefax: +385 1 2406 790

### CZECHIA
BOHLER UDDEHOLM CZ s.r.o.
Division Uddeholm
U silnice 949
161 00 Praha 6 Ruzyne
Czech Republic
Telephone: +420 233 029 850,8
Telefax: +420 233 029 859

### DENMARK
UDDEHOLM A/S
Kokmose 8, Bramdrupdam
DK-6000 Kolding
Telephone: +45 75 51 70 66
Telefax: +45 75 51 70 44

### ESTONIA
UDDEHOLM TOOLING ESTI OÜ
Silikatsiidi 7
EE-11216 Tallinn, Estonia
Telephone: +372 655 9180
Telefax: +372 655 9181

### FINLAND
OY UDDEHOLM AB
Ritakuja 1, PL 57,
FIN-01741 VANTAA
Telephone: +358 9 290 490
Telefax: +358 9 2904 9249

### FRANCE
UDDEHOLM S.A.
12 Rue Mercier, Z.I. de Mitry-Compans
F-77297 Mitry Mory Cedex
Telephone: +33 (0)1 60 93 80 10
Telefax: +33 (0)1 60 93 80 01

*Branch office*
UDDEHOLM S.A.
77bis, rue de Vesoul
La Nef aux Métiers
F-25000 Besançon
Telephone: +33 381 53 12 19
Telefax: +33 381 53 13 20

### GERMANY
UDDEHOLM
Hansaallee 321
D-40549 Düsseldorf
Telephone: +49 211 535 10
Telefax: +49 211 535 12 80

*Branch offices*
UDDEHOLM
Falkenstraße 21
D-65812 Bad Soden/TS.
Telephone: +49 6196 659 60
Telefax: +49 6196 659 625

UDDEHOLM
Albstraße 10
D-73765 Neuhausen
Telephone: +49 715 898 65-0
Telefax: +49 715 898 65-25

### GREAT BRITAIN, IRELAND
UDDEHOLM UK LIMITED
European Business Park
Taylors Lane, Oldbury
West Midlands B69 2BN
Telephone: +44 121 552 55 11
Telefax: +44 121 544 29 11

*Dublin* Telephone: +353 1 45 14 01

### GREECE
UDDEHOLM STEEL TRADING
COMPANY
20, Athinon Street
G-Piraeus 18540
Telephone: +30 2 10 41 72 109/41 29 820
Telefax: +30 2 10 41 72 767

*Agency*
SKLERO S.A.
Steel Trading Comp. and
Hardening Shop
Frixou 11/Nikif. Ouranou
G-54627 Thessaloniki
Telephone: +30 31 51 46 77
Telefax +30 31 54 12 50

SKLERO S.A.
Heat Treatment and Trading of Steel
Uddeholm Tool Steels
Industrial Area of Thessaloniki
P.O. Box 1123
G-57022 Sindos, Thessaloniki
Telephone: +30 23 10 79 76 46
Telefax: +30 23 10 79 76 78

### HUNGARY
UDDEHOLM TOOLING/BOK
Dunaharaszti, Jedlik Ányos út 25
H-2331 Dunaharaszti 1.Pf. 110
Telephone/Telefax: +36 24 492 690

### ITALY
UDDEHOLM div. della Bohler
Uddeholm Italia S.p.A.
Via Palizzi, 90
I-20157 Milano
Telephone: +39 02 35 79 41
Telefax: +39 02 390 024 82

### LATVIA
UDDEHOLM TOOLING AB
Piedrujas street 7
LV-1037 Riga, Latvia
Telephone: +371 7 701 983, -981, -982
Telefax: +371 7 147 373

### LITHUANIA
UDDEHOLM TOOLING AB
BE PLIENAS IR METALAI
T. Masiulio 18b
LT-52459 Kaunas
Telephone: +370 37 370613, -669
Telefax: +370 37 370300

### THE NETHERLANDS
UDDEHOLM B.V.
Isolatorweg 30
NL-1014 AS Amsterdam
Telephone: +31 20 581 71 11
Telefax: +31 20 684 86 13

### NORWAY
UDDEHOLM A/S
Jernkroken 18
Postboks 85, Kalbakken
N-0902 Oslo
Telephone: +47 22 91 80 00
Telefax: +47 22 91 80 01

### POLAND
INTER STAL CENTRUM
Sp. z. o.o./Co. Ltd.
ul. Kolejowa 291, Dzieków Polski
PL-05-092 Lomianki
Telephone: +48 22 429 2260
Telefax: +48 22 429 2266

### PORTUGAL
F RAMADA Aços e Industrias S.A.
P.O. Box 10
P-3881 Ovar Codex
Telephone: +351 56 58 61 11
Telefax: +351 56 58 60 24

### ROMANIA
BÖHLER Romania SRL
Uddeholm Branch
Str. Atomistilor Nr 14A
077125 Magurele Jud Ilfov
Telephone: +40 214 575007
Telefax: +40 214 574212

### RUSSIA
UDDEHOLM TOOLING CIS
25 A Bolshoy pr PS
197198 St. Petersburg
Telephone: +7 812 233 9683
Telefax: +7 812 232 4679

### SLOVAKIA
UDDEHOLM Slovakia
Nástrojové ocele, s.r.o
KRÁCINY 2
036 01 Martin
Telephone: +421 842 4 300 823
Telefax: +421 842 4 224 028

### SLOVENIA
UDDEHOLM div. della Bohler
Uddeholm Italia S.p.A.
Via Palizzi, 90
I-20157 Milano
Telephone: +39 02 35 79 41
Telefax: +39 02 390 024 82

### SPAIN
UDDEHOLM
Guifré 690-692
E-08918 Badalona, Barcelona
Telephone: +34 93 460 1227
Telefax: +34 93 460 0558

*Branch office*
UDDEHOLM
Barrio San Martin de Arteaga, 132
Pol.Ind. Torrelarragoiti
E-48170 Zamudio
(Bizkaia)
Telephone: +34 94 452 13 03
Telefax: +34 94 452 13 58

### SWEDEN
UDDEHOLM TOOLING
SVENSKA AB
Aminogatan 25
SE-431 53 Mölndal
Telephone: +46 31 67 98 50
Telefax: +46 31 27 02 94

### SWITZERLAND
HERTSCH & CIE AG
General Wille Strasse 19
CH-8027 Zürich
Telephone: +41 44 208 16 66
Telefax: +41 44 201 46 15

## UDDEHOLM NORTH AMERICA

### USA
UDDEHOLM
4902 Tollview Drive
Rolling Meadows, IL 60008
Sals Phone: +1 800 638 2520
Sales Fax: +1 630 350 0880

*Region East Warehouse*
UDDEHOLM – Shrewsbury, MA

*Region Central Warehouse*
UDDEHOLM – Wood Dale, IL

*Region West Warehouse*
UDDEHOLM – Santa Fe Springs, CA

### CANADA
UDDEHOLM
2595 Meadowvale Blvd.
Mississauga, ON L5N 7Y3
Telephone: +1 905 812 9440
Telefax: +1 905 812 8658

*Branch Warehouses*
UDDEHOLM – St. Laurent, QC
UDDEHOLM – New Westminster, BC

*Heat Treating*
THERMO-TECH – Mississauga, ON

### MEXICO
ACEROS BOHLER UDDEHOLM,
S.A. de C.V.
Calle 8 No 2, Letra "C"
Fraccionamiento Industrial Alce Blanco
C.P. 52787 Naucalpan de Juarez
Estado de Mexico
Telephone: +52 55 9172 0242
Telefax: +52 55 5576 6837

UDDEHOLM
Lerdo de Tejada No.542
Colonia Las Villas
66420 San Nicolas de Los Garza, N.L.
Telephone: +52 8-352 5239
Telefax: +52 8-352 5356

## UDDEHOLM SOUTH AMERICA

### ARGENTINA
UDDEHOLM S.A
Mozart 40
1619-Centro Industrial Garin
Garin-Prov. Buenos Aires
Telephone: +54 332 744 4440
Telefax: +54 332 745 3222

### BRAZIL
UDDEHOLM ACOS ESPECIAIS Ltda.
Estrada Yae Massumoto, 353
CEP 09842-160
Sao Bernardo do Campo - SP Brazil
Telephone: +55 11 4393 4560, -4554
Telefax: +55 11 4393 4561

## UDDEHOLM SOUTH AFRICA
UDDEHOLM Africa (Pty) Ltd.
P.O. Box 539
ZA-1600 Isando/Johannesburg
Telephone: +27 11-974 2781
Telefax: +27 11-392 2486

## UDDEHOLM AUSTRALIA
BOHLER-UDDEHOLM Australia
129-135 McCredie Road
Guildford NSW 2161
Private Bag 14
Telephone: +61 2 9681 3100
Telefax: +61 2 9632 6161

*Branch offices*
Sydney, Melbourne, Adelaide,
Brisbane, Perth, Newcastle,
Launceston, Albury, Townsville

## ASSAB

### ASSAB INTERNATIONAL
Skytteholmsvägen 2
P O Box 42
SE-171 11 Solna
Sweden
Telephone: +46 8 564 616 70
Telefax: +46 8 25 02 37

*Subsidiaries*
India, Iran, Turkey, United Arab
Emirates, Saudi Arabia

*Distributors in*
Africa, Latin America, Middle East

### ASSAB PACIFIC
ASSAB Pacific Pte. Ltd
171, Chin Swee Road
No. 07-02, San Centre
Singapore 169877
Telephone: +65 534 56 00
Telefax: +65 534 06 55

*Subsidiaries*
China, Hong Kong, Indonesia, Japan,
Korea, Malaysia, Philippine Islands,
Singapore, Taiwan, Thailand

HAGFORS KLARTEXT U060102.500 / Tryckeri Knappen, Karlstad 200601

When the first idea pops into your head, throughout the development process to the release of the new product, we'll be your partner. As the world's leading supplier of tooling materials and related services, we can be trusted. Meet us under the Uddeholm and ASSAB brands, wherever in the world you have your business.

UDDEHOLM
WWW.UDDEHOLM.COM

Edition: 5, 01.2006