

PROTHERM

High conductivity beryllium copper mould alloy

COLD WORK

PLASTIC MOULDING

HOT WORK

HIGH PERFORMANCE STEEL



This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

General

PROTHERM is a moderate strength high conductivity beryllium copper mould alloy made by Brush Wellman Inc. Specially developed for plastics processing applications, its main properties include:

- extremely high thermal conductivity
- excellent corrosion resistance
- good polishability and machinability
- good resistance to galling
- excellent weldability
- rapid, uniform heat transfer
- resistance to high temperature, e.g. for engineering thermoplastics
- ability to be coated for higher wear resistance.

Typical analysis %	Be 0,4	Ni 1,8	Cu Bal.
Delivery condition	190 HB		
Colour code	Pink		

PROTHERM, which is available in wrought round and flat sections, machined core pins and welding wire, provides the highest thermal conductivity available in a mould material—ten times that of steel and twice that of aluminium. This important feature ensures maximum, uniform heat transfer to achieve:

- optimum production cycle times
- reduction or elimination of cooling channels
- elimination of hot spots
- improved plastic part quality
- rapid, uniform heating in hot runners
- maximum heat transfer in nozzles.

Recommended application areas for *PROTHERM* include injection moulds, blow moulds, cores and inserts for all plastics, including corrosive grades, RIM moulds and expendable polystyrene foam processing. It is also an ideal material choice for nozzle tips, edge gates and manifolds for hot runner systems and whenever short cycle times are important.

For mould applications which require a higher working hardness than that of *PROTHERM*, *MOLDMAX* beryllium copper mould alloy is available, see separate technical brochure. When used with *MOLDMAX*; *PROTHERM* should be located in contact with cooling water to boost heat transfer. *MOLDMAX* should be used in contact with the plastic where strength and wear resistance are required. *MOLDMAX* and *PROTHERM* can be used in the same tool set to provide optimum tool performance.

Applications

The extremely high thermal conductivity of *PROTHERM* beryllium copper mould alloy makes it a suitable material for many moulding situations where rapid and uniform heat transfer is required. These include:

- Injections mould, blow moulds, cores and inserts for all plastics, including corrosive grades.
- Nozzle tips, edge gates and manifolds for hot runner systems.
- Moulds for RIM and expendable foam processing.



PROTHERM is especially recommended for nozzle tips, edge gates and manifold in hot runner systems.

Properties

PHYSICAL DATA

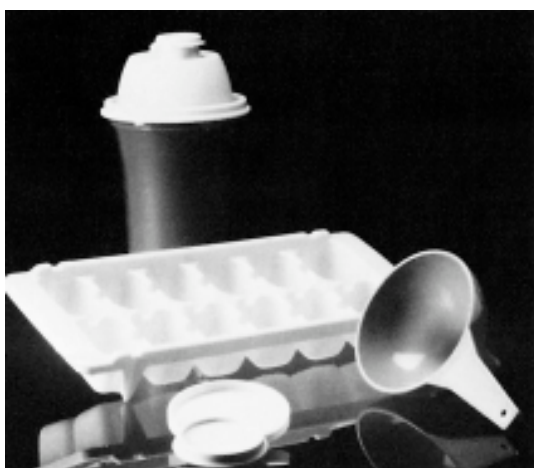
Age-hardened to approximately 190 Brinell. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	300°C (570°F)
Density kg/m ³ lb/in ³	8 820 0,319	8 737 0,316	8 682 0,314
Modulus of elasticity N/mm ² psi	138 400 20 x 10 ⁶	131 000 19 x 10 ⁶	117 200 17 x 10 ⁶
Coefficient of thermal expansion °C from 20°C °F from 68°F	— —	17,2 x 10 ⁻⁶ 9,8 x 10 ⁻⁶	18 x 10 ⁻⁶ 10,4 x 10 ⁻⁶
Thermal conductivity W/m°C Btu in/ft ² h °F	225 1 543	265 1 817	275 1 886
Specific heat J/kg°C Btu/lb °F	380 0,091	480 0,114	535 0,128

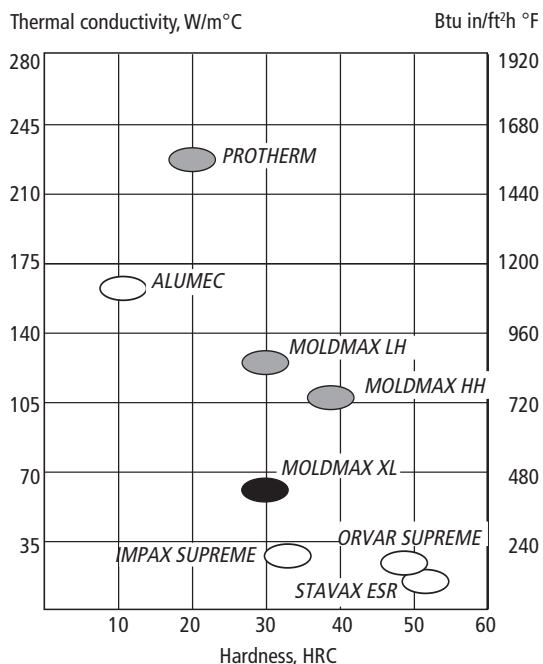
TENSILE STRENGTH AT ROOM TEMPERATURE

The tensile values are to be considered as approximate only.

Hardness	Approx. 190 Brinell
Compressive yield strength R _{c0,2} psi N/mm ²	~92 800 ~640
Tensile yield strength, R _{p0,2} psi N/mm ²	~90 000 ~620
Tensile strength, R _m psi N/mm ²	~114 500 ~790
Elongation, A ₅ %	20



Relation between strength and heat conductivity for different mould material.



Note: Increasing alloying content gives a higher strength, but a lower thermal conductivity. However, this is only valid when comparing material within one material group i.e. steel must be compared with steel and copper with copper alloys.

Heat treatment

PROTHERM is delivered in the heat treated condition. Additional heat treatment is not recommended.

Machining

PROTHERM has a very good machinability and can be machined with conventional cutting tools.

Perform machining wet, to avoid breathing metal dust.

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions.

TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	
Cutting speed, v_c m/min f.p.m.	300–400 990–1300	400–550 1300–1800	150–200 500–660
Feed, f mm/rev i.p.r	0,3–0,6 0,012–0,023	–0,3 –0,012	–0,3 –0,012
Depth of cut, a_p mm inch	2–6 0,08–0,23	–2 –0,08	–2 –0,08
Carbide designation ISO	K20	K20	–

Use tools with generous positive rake angles.

MILLING

Face and square shoulder face milling

Cutting data parameters	Milling with carbide		Milling with high speed steel
	Rough milling	Fine milling	
Cutting speed, v_c m/min f.p.m.	250–400 820–1300	400–600 1300–1980	150–200 500–660
Feed, f_z mm/tooth in/tooth	0,2–0,4 0,008–0,016	0,1–0,2 0,004–0,008	–0,1 –0,004
Depth of cut, a_p mm inch	2–5 0,08–0,20	–2 –0,08	–2 –0,08
Carbide designation ISO	K20	K20	–

Use tools with positive rake angles when milling with carbide.

End milling

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed, v_c m/min f.p.m.	180–200 590–660	400–500 1300–1650	150–180 ¹⁾ 490–590
Feed, f_z mm/tooth in/tooth	0,015–0,12 ²⁾ 0,0006–0,005	0,08–0,20 ²⁾ 0,003–0,008	0,05–0,35 ²⁾ 0,002–0,014
Carbide designation ISO	–	K20	–

¹⁾ For coated HSS end mill an increased cutting speed of ~30% can be used.

²⁾ Depending on radial depth of cut and cutter diameter.

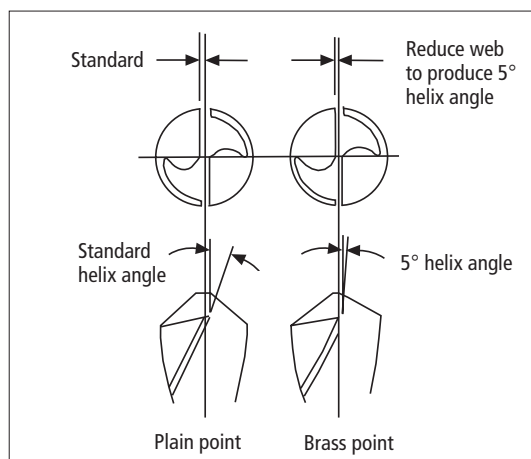
DRILLING

High speed steel twist drill

Drill diameter		Cutting speed v_c		Feed	
mm	inch	m/min	f.p.m.	mm/r	i.p.r
–5	–3/16	35–50	11–16	0,03–0,10	0,001–0,004
5–10	3/16–3/8	35–50	11–16	0,10–0,20	0,004–0,008
10–15	3/8–5/8	35–50	11–16	0,20–0,25	0,008–0,010
15–20	5/8–3/4	35–50	11–16	0,25–0,30	0,010–0,012

When drilling holes deeper than 1 x drill diameter use "Peckdrilling" and retract the drill after each 5 mm drilled depth.

Standard HSS drills can be used but for best performance the tip should be altered to a "brass point" according to the figure below.



THREADING WITH TAP

When tapping PROTHERM use taps with straight flutes. Use same kind of taps when tapping blind holes. Suitable cutting speed 6–8 m/min. Use cutting compound or cutting oil.

GRINDING

Conventional grinding wheels can be used when grinding *PROTHERM*. Surface grinding, use A 46 LV-type of wheels. Cylindrical grinding, use A 60 LV-type of wheels.

All grinding should be done wet to avoid breathing metal dust.

Polishing

PROTHERM has very good polishability and highly glossy surfaces are readily achievable. The following steps can serve as guidelines:

1. After grinding, pre-polish using successively finer grit stones ending with a 600 grit.
2. Polish with diamond paste grade 15 to obtain a dull satin looking surface.
3. Polish with a grade 6 diamond paste.
4. Polish with a grade 3 diamond paste.
5. If necessary, hand finish with a #1 grade diamond paste.

As in all polishing, work thoroughness and cleanliness are of utmost importance. In order to avoid overpolishing, or "orange peel" effect, do not polish longer than necessary to achieve an even looking surface.

Welding

PROTHERM can easily be welded if good care is taken and good welding practices are followed. The area to be welded should be thoroughly cleaned with a degreasing solvent. The always present oxidized layer should be removed using aggressive brushing, sand blasting or acid pickling immediately prior to the welding.

For best results TIG (GTAW) or MIG (GMAW) is recommended. Suitable welding consumables are available for welding *PROTHERM*.

The weld and the surrounding area will show a lower hardness. If the strength of the weld is crucial, the whole part needs to be re-heat treated including solution annealing, quenching and agehardening. After such a treatment the weld will have the same strength as the base material.

For more information, contact your local Uddeholm office.

Welding operations should employ adequate ventilation to eliminate welding fumes or respirators should be used by those in the welding area.

EDM

While *PROTHERM*'s high thermal conductivity makes it typically 20% slower to EDM than mould steel, EDM'ing presents no significant problem. For further details, contact your local Uddeholm office.

Proper ventilation with an effective exhaust system is essential to prevent fumes in the air.

Safe handling

PROTHERM is a copper-alloy with a content of $\approx 0,5\%$ Beryllium.

Make sure, during the machining of *PROTHERM*, to avoid breathing metal dust fume or mist. Perform machining, grinding and polishing wet when possible. If dry operation is needed use ventilation to capture the dust.

Further information can be found in our "Material Safety" data sheets.

Further information

Contact your local Uddeholm office for additional information on selection, heat treatment, application and availability of Uddeholm tooling materials.

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 Ruzyně
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 AB
Silikatsiidi 7
EE-0012 Tallinn
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 12 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

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

HUNGARY

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

ITALY

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
Deglava street 50
LV-1035 Riga
Telephone: +371 7 701 983, -981, -982
Telefax: +371 7 701 984

LITHUANIA

UDDEHOLM TOOLING AB
BE PLIENAS IR METALAI
T. Masiulio 18b
LT-3014 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, Dziekanów 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
KRÁČINY 2
036 01 Martin
Telephone: +421 842 4 300 823
Telefax: +421 842 4 224 028

SLOVENIA

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. Torrelarraigoiiti
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 1 208 16 66
Telefax: +41 1 201 46 15

UDDEHOLM

NORTH AMERICA

USA

UDDEHOLM
4902 Tollview Drive
Rolling Meadows IL 60008
Telephone: +1 847 577 22 20
Telefax: +1 847 577 80 28

UDDEHOLM

548 Clayton Ct.,
Wood Dale IL 60191
Telephone: +1 630 350 10 00
Telefax: +1 630 350 08 80

UDDEHOLM

9331 Santa Fe Springs Road
Santa Fe Springs, CA 90670
Telephone: +1 562 946 65 03
Telefax: +1 562 946 77 21

UDDEHOLM

220 Cherry Street
Shrewbury, MA 01545
Telephone: +1 508 845 1066
Telefax: +1 508 845 3471

CANADA

UDDEHOLM LIMITED
2595 Meadowvale Blvd.
Mississauga, Ontario L5N 7Y3
Telephone: +1 905 812 9440
Telefax: +1 905 812 8659

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
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

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.



WWW.UDDEHOLM.COM

Edition: 3, 08.2002