

MOLDMAX HH

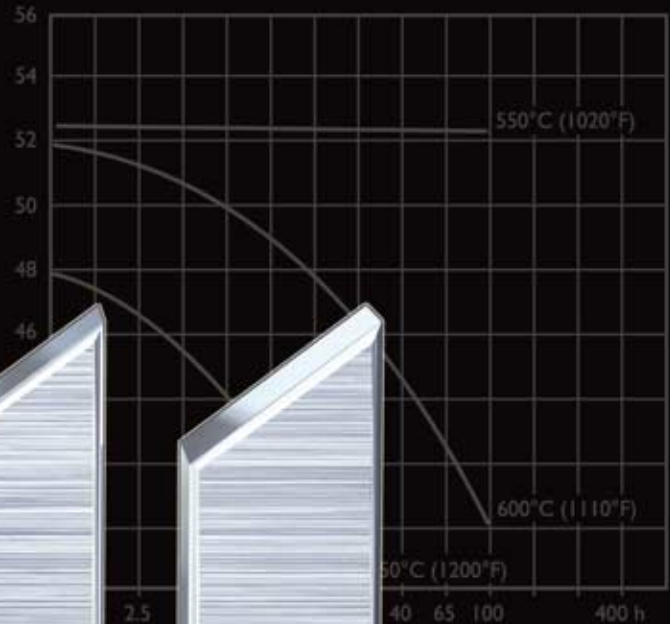
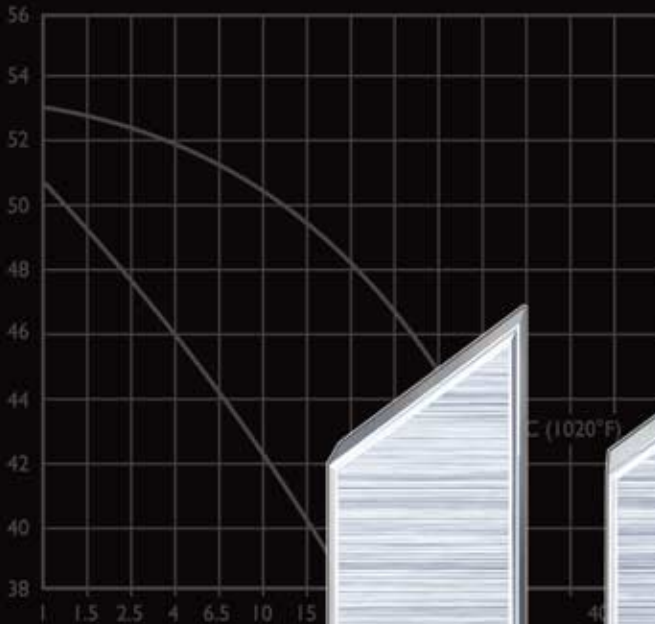
High strength beryllium copper mould alloy

COLD WORK

PLASTIC MouldING

HOT WORK

HIGH PERFORMANCE STEEL



Typical analysis %	C 2,05	Mn 0,8	Cr 4,5	W 0,2
Standard specification	AISI D6, ()	D3) (W.Nr. 1.2796)		
Delivery condition	Soft annealed	to approx. 200 HB		
Colour code	Red	Your colour		

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m ³ lbs/m ³	7 770 0,281	7 700 0,277	7 650 0,275
Modulus of elasticity N/mm ² psi	194 000 28,1 × 10 ⁶	188 000 27,3 × 10 ⁶	173 000 25,1 × 10 ⁶
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	to 100°C 11,7 × 10 ⁻⁶ to 212°F 6,5 × 10 ⁻⁶	to 200°C 12 × 10 ⁻⁶ to 400°F 6,7 × 10 ⁻⁶	to 400°C 13,0 × 10 ⁻⁶ to 750°F 7,3 × 10 ⁻⁶
Thermal conductivity W/m °C Btu in (ft ² h°F)	- -	27 187	32 221
Specific heat K/kg °C Btu/lbs °F	455 0,109	525 0,126	608 0,145
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	to 100°C 12,3 × 10 ⁻⁶ to 212°F 6,1 × 10 ⁻⁶	to 200°C 14 × 10 ⁻⁶ to 400°F 6,7 × 10 ⁻⁶	to 400°C 15,1 × 10 ⁻⁶ to 750°F 7,3 × 10 ⁻⁶
Thermal conductivity W/m °C Btu in (ft ² h°F)	- -	20,5 142	21,5 149
Specific heat K/kg °C Btu/lbs °F	460 0,110	- -	- -

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

MOLDMAX HH is a high-strength beryllium copper mould alloy made by Brush Wellman Inc. for plastics moulding applications. Its main properties include:

- high thermal conductivity
- good corrosion resistance
- good polishability
- good wear resistance
- good resistance to galling
- good machinability
- high strength and hardness
- excellent weldability.

Typical analysis %	Be 1,9	Co + Ni 0,25	Cu Bal.
Delivery condition	High hard = 40 HRC (Low hard = 30 HRC)		
Colour code	HH Black/Gold LH Red/Gold		

MOLDMAX HH is widely used for injection moulding tools or as cores and inserts in steel moulds. When used in steel mould it effectively cools hot spots, reducing or eliminating the need for cooling channels.



Two halves of a MOLDMAX HH beryllium copper blow mould.

MOLDMAX HH is available in wrought round and flat section, machined core pins, and welding wire.

MOLDMAX HH's high thermal conductivity, 3 to 4 times better than steel, ensures uniform, rapid heat removal, minimizing part distortion, warpage, poor replication of detail and similar defects. In many cases it can significantly reduce cycle times, even when used in a steel mould just for selected cores and inserts.

For mould applications which require even higher thermal conductivity than that of *MOLDMAX HH*, *PROTHERM* beryllium copper mould alloy is available, see separate technical brochure.

Applications

The special properties of *MOLDMAX HH* beryllium copper alloy make it a suitable mould/core/insert material for a wide variety of moulding situations but especially where a combination of high thermal conductivity, corrosion resistance and good polishability are needed.

- Blow moulds: pinch offs, neck rings and handle inserts.
- Injection mould: moulds, cores, inserts.
- Injection nozzles and manifolds for hot runner systems.

Properties

PHYSICAL DATA

Data at room and elevated temperatures.

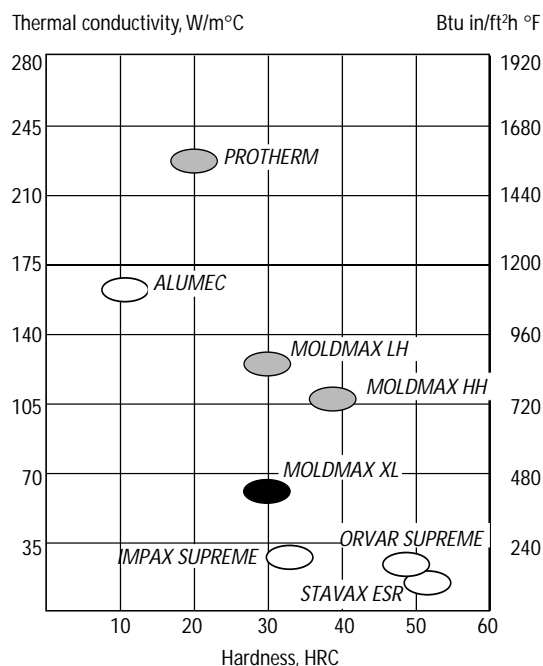
Temperature	20°C (68°F)	200°C (390°F)	300°C (570°F)
Density kg/m ³ lb/in ³	8 350 0,302	8 275 0,299	8 220 0,297
Modulus of elasticity N/mm ² psi	131 100 19 x 10 ⁶	124 100 19 x 10 ⁶	103 400 15 x 10 ⁶
Coefficient of thermal expansion from °C to 20°C from °F to 68°F	- -	17 x 10 ⁻⁶ 9,7 x 10 ⁻⁶	17,8 x 10 ⁻⁶ 9,9 x 10 ⁻⁶
Thermal conductivity W/m°C HH 40 HRC LH 30 HRC	110 120	145 160	155 170
Btu in/ft ² h °F HH 40 HRC LH 30 HRC	754 823	994 1097	1063 1166
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	HH 40 HRC	LH 30 HRC
Tensile strength, R _m N/mm ² psi	1 280 185 000	1 170 170 000
Compressive yield strength, R _{c0,2} N/mm ² psi	1 070 155 000	970 140 000
Elongation, A ₅ %	6	8

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

MOLDMAX HH is delivered in the heat treated condition—additional heat treatment is not normally required.



Machining

MOLDMAX HH has a good machinability and can be machined with conventional cutting tools. Perform machining wet to avoid breathing metal dust.

The cutting data below, for MOLDMAX HH, 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.	270–300 890–990	300–370 990–1220	60–90 200–300
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.	100–150 330–490	150–200 490–660	45–60 150–200
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.	80–100 260–330	150–200 490–660	45–60 ¹⁾ 150–200
Feed, f_z mm/tooth in/tooth	0,010–0,10 ²⁾ 0,0004–0,004	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.

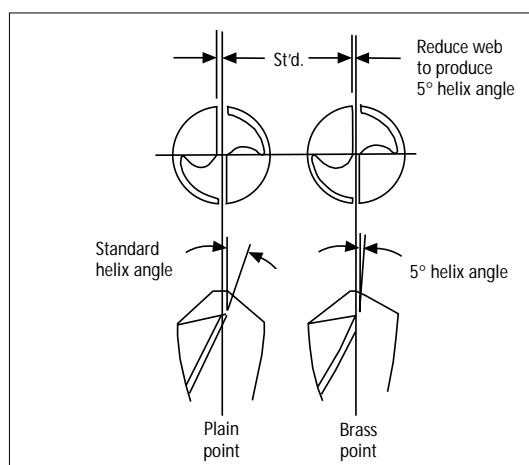
DRILLING

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	30–40	100–130	0,03–0,08	0,001–0,003
5–10	3/16–3/8	30–40	100–130	0,08–0,15	0,003–0,006
10–15	3/8–5/8	30–40	100–130	0,15–0,20	0,006–0,008
15–20	5/8–3/4	30–40	100–130	0,20–0,25	0,008–0,010

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 MOLDMAX HH 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 *MOLDMAX HH*. Surface grinding, use A 54 LV-type of wheels. Cylindrical grinding, use A 60 LV-type of wheels.

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

Surface treatments

To enhance the surface properties of *MOLDMAX HH*, standard treatments can be applied.

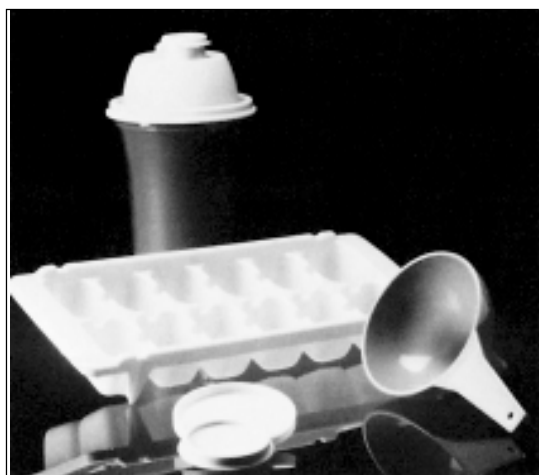
Treatment	Benefits
Hard chrome	Wear resistance, corrosion resistance, hardness.
Electroless (chemical) Nickel	Hardness, wear resistance, surface release, corrosion resistance.
Electroless Nickel with Teflon	Hardness, wear resistance, surface release
PVD: Titanium Nitride Chromium Nitride	Superior wear resistance, surface release.

Note: Treatment temperature should not exceed 320°C (610°F).

EDM

While *MOLDMAX HH*'s high thermal conductivity makes it slower to EDM than mould steel, EDM'ing presents no significant problem.

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



Welding

MOLDMAX HH 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 *MOLDMAX HH*.

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 age-hardening. 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 be carried out using properly designed local exhaust ventilation to draw all fumes away from the operator and through an appropriate filter before venting outside of the work area.

Polishing

MOLDMAX HH 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.

Safe handling

MOLDMAX HH is a copper-alloy with a content of ≈2% Beryllium.

Make sure, during the machining of *MOLDMAX HH*, 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.