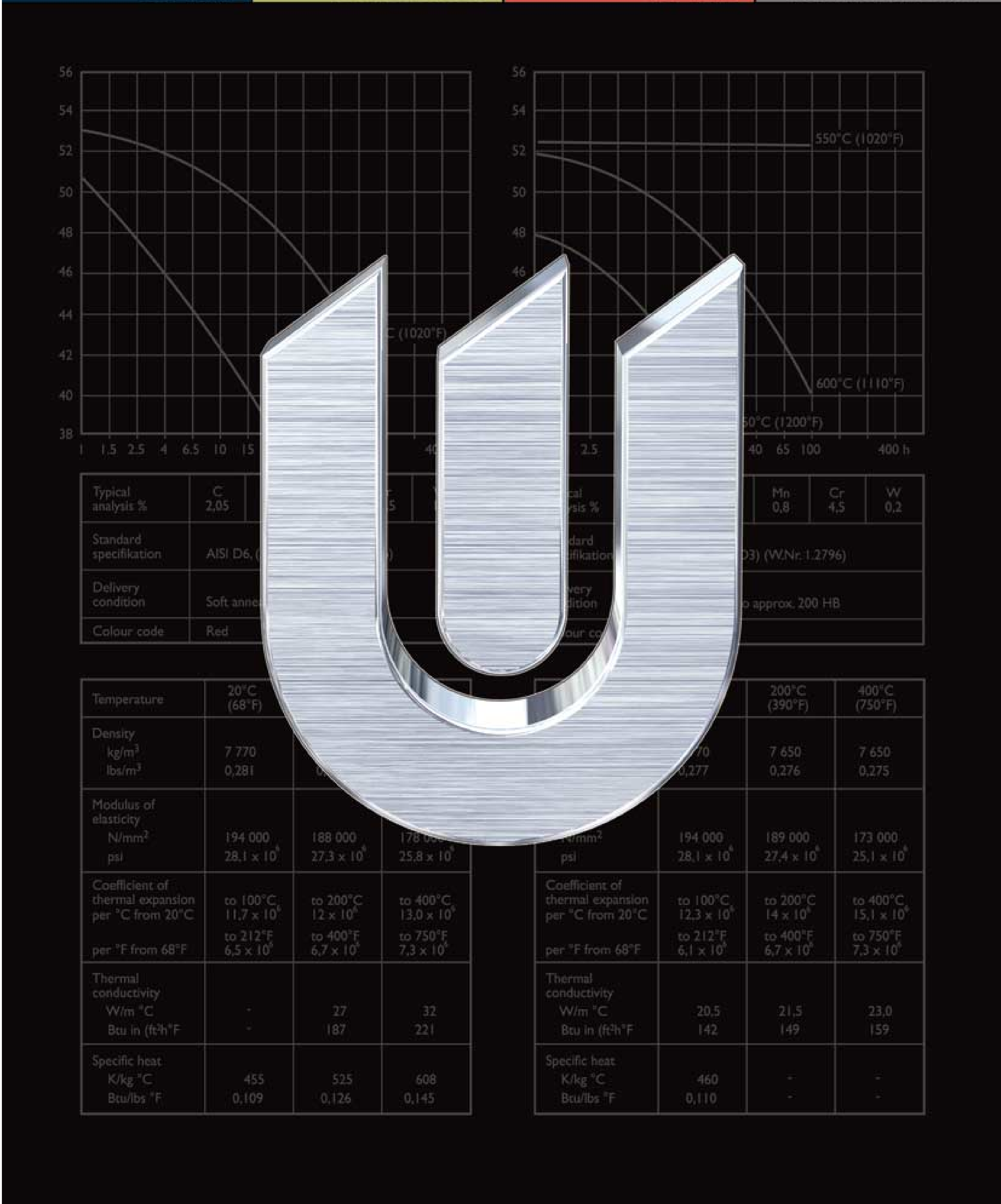
ALUMEC

High strength aluminium

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



General

ALUMEC is a high strength aluminium alloy supplied in the form of hot rolled, heat treated plate. It undergoes a special cold stretching operation for maximum stress relieving. Thanks to its high strength and good stability, *ALUMEC* has become widely used in the tooling industry.

Delivery condition: heat treated to 146–180 Brinell.

ALUMEC has the following characteristics which make it suitable for many types of tools especially plastics moulds:

- **Excellent Machinability**
  High cutting speeds, reduced machining time, lower tooling costs, quicker deliveries.
- **Low Weight**
  The low weight, which is approximately 1/3 of the weight of steel, allows easier and more convenient tool handling. Low inertia makes it possible to speed up closing and opening of moulds.
- **High Thermal Conductivity**
  Cycle times are reduced and less complicated cooling systems may be used.
- **Good Stability**
  A special stress relieving operation guarantees minimal deformation during and after machining.
- **Good Corrosion Resistance**
  Good resistance against all commonly used plastics materials.
- **Suitable for Surface Treatments**
  ALUMEC can be hard anodized, hard chromium or nickel plated for increased hardness, wear resistance and corrosion resistance.

Application areas

The properties and characteristics which *ALUMEC* offers make it an ideal material for prototype tools and for moulding short and medium length production runs which are not subjected to high pressures or abrasive plastics. Considerably shorter tool making times, lower tooling costs and shorter cycle times give valuable savings both for the toolmaker and the tool user when using *ALUMEC.*

	Tooling Category			
Application Areas	Proto-types	Short runs	Medium runs	Long runs
Blow moulding	X	X	X	X
Vacuum forming	X	X	X	X
Foam moulding	X	X	X	(X)
RIM-moulding	X	X	X	(X)
Injection moulding of thermoplastics	X	X	(X)	
Rubber moulding	X	X		
Holders and support plates, jigs and fixtures				

Properties

PHYSICAL DATA

Values at room temperature unless stated otherwise.

Density	kg/m³ lbs/in³	2 830 0,102
Modulus of elasticity	N/mm² psi	71 500 10,3 x 10^6
Coefficient of thermal expansion per °C from 20°C to 100°C per °F (68–212°F)		 23 x 10^{-6} 12,8 x 10^{-6}
Thermal conductivity	W/m °C Btu in/ft²h °F	165 1 144
Specific heat	J/kg °C Btu/lb. °F	890 0,20

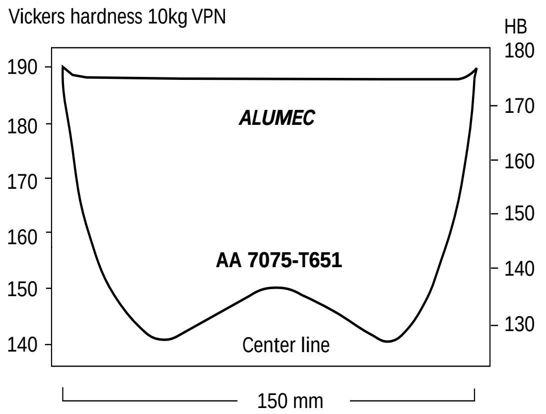
TENSILE STRENGTH

Tensile strength values, which for most practical purposes can be compared to compression strength values, should be regarded as typical.
Values at room temperature for different plate thicknesses.

Plate (thickness) mm	Tensile strength N/mm²	Yield strength N/mm²
> 10–50 > 50–100 >100–150 >150–200 >200–300	590 570 550 535 430	550 520 500 485 365
Round bar (diameter) mm		
40 100 200	680 680 670	630 620 610

Note that the plate is tested in the transverse direction and the round bar in the length direction.

Hardness distribution through the plate cross section



Machining

GENERAL

A major advantage when machining aluminium alloys is the possibility of using high cutting speeds. The reason is the low cutting force needed compared with steel and brass. Because of the excellent combination of mechanical and physical properties in *ALUMEC* the maximum cutting speed possible is very high, when suitable cutting tools are used. When using high speed milling machines, cutting speeds exceeding 3 500 m/min. (11 500 ft./min.) has been used with good results.

CUTTING TOOL— DESIGN AND MATERIAL

Although aluminium alloys give low cutting forces, it is necessary to use high quality cutting tools. In order to achieve the highest possible cutting speed the use of cemented carbide tools, especially during turning and end milling, is ideal.
The same cutting tools normally used for steel can also be used for machining of *ALUMEC*. However, for good production economy, tools with large positive angles should be used. The flute should have a large chip space and be polished to prevent chips clogging the cutter.
When sawing *ALUMEC*, a coarse tooth saw blade is recommended.

COOLING/LUBRICATION

The purpose of cutting fluid is to cool the work piece and to lubricate the cutting tool. Because of the high cutting speeds possible when machining *ALUMEC*, cooling is important, although the heat conductivity of *ALUMEC* is very high. Good lubrication is of special importance during deep hole drilling, as there is a prolonged contact between chips and tool.
Cutting fluids recommended for steel may sometimes discolor the aluminium surface, if PH values are high. Most manufacturers of cutting fluid have universal fluids suitable for both steel and aluminum.

Cutting data recommendations

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

TURNING

	Rough turning with carbide	Fine turning with carbide	Fine turning with PCD[1]	Turning with high speed steel
Cutting speed (v_c) m/min f.p.m.	600–1200 1980–3960	1200–2500 3960–8250	600–1500 1980–4950	250–300 825–990
Feed (f) mm/r i.p.r.	0,3–1,0 0,012–0,04	–0,3 –0,012	–0,3 –0,012	–0,3 –0,012
Depth of cut (a_p) mm inch	2–6 0,08–0,24	–2 –0,08	–3 –0,12	–3 –0,12
Carbide designation ISO	K20	K10	–	–

[1] Polycrystallin diamond.

MILLING

Face and square shoulder face milling

	Rough milling with carbide	Fine milling with carbide	Fine milling with PCD[1]	Milling with high speed steel
Cutting speed (v_c) m/min f.p.m.	600–1000 1980–3300	1000–3000 3300–9900	800–4000 2650–13200	250–400 825–1320
Feed (f_z) mm/tooth in/tooth	0,2–0,6 0,008–0,024	0,1–0,2 0,004–0,008	0,05–0,2 0,002–0,008	–0,4 –0,016
Depth of cut (a_p) mm inch	2–8 0,08–0,32	–2 –0,08	–2 –0,08	–8 –0,32
Carbide designation ISO	K20	K10	–	–

[1] Polycrystallin diamond.

End milling

	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_c) m/min f.p.m.	300–500 990–1650	300–500 990–1650	120–250 400–825
Feed (f_z) mm/tooth inch/tooth	0,03–0,20[1] 0,001–0,008[1]	0,08–0,20[1] 0,003–0,008[1]	0,05–0,35[1] 0,002–0,014[1]
Carbide designation ISO	–	K20	–

[1] Depending on the radial depth of cut and cutter diameter.

DRILLING

High speed steel twist drill[1]

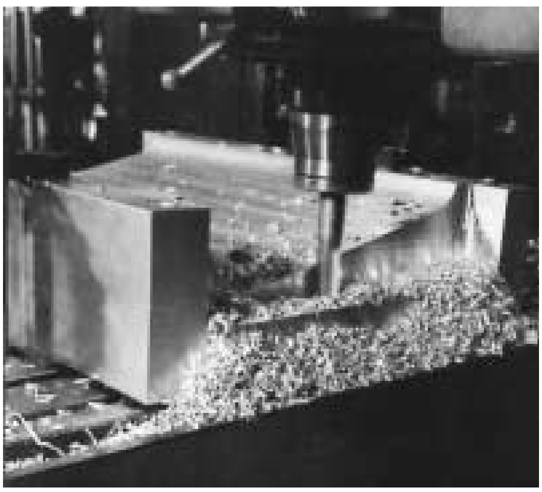
Drill diameter mm	inch	Cutting speed (v_c) m/min	f.p.m.	Feed (f) mm/r	i.p.r.
– 5	–3/16	50–70	165–230	0,08–0,20	0,003–0,008
5–10	3/16–3/8	50–70	165–230	0,20–0,30	0,008–0,012
10–15	3/8–5/8	50–70	165–230	0,30–0,35	0,012–0,014
15–20	5/8–3/4	50–70	165–230	0,35–0,40	0,014–0,016

[1] Point angel 118° helix angle 16–30°.

Carbide drill

	Indexable insert	Solid carbide	Brazed carbide[1]
Depth of cut (v_c) m/min f.p.m.	200–400 665–1330	200–300 665–990	200–300 665–990
Feed (f) mm/r i.p.r.	0,05–0,25[2] 0,002–0,01[2]	0,10–0,25[2] 0,004–0,01[2]	0,15–0,25[2] 0,006–0,01[2]

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



Milling ALUMEC.

GRINDING

A general grinding wheel recommendation is given below. For grinding of *ALUMEC* use silicon carbide abrasive. Cutting oil is recommended as grinding fluid.

Type of grinding	Wheel recommendation
Face grinding straight wheel	C 46 H V
Face grinding segments	C 24 G V
Cylindrical grinding	C 60 J V
Internal grinding	C 46 H V
Profile grinding	C 100 L V

Polishing guidelines

GENERAL

Maintain a clean work environment and ensure that the work piece is flushed with an appropriate industrial solvent to prevent accumulation of polishing debris.
Use large tools wherever possible to prevent high levels of localized pressure leading to surface degradation.
Renew grinding paper frequently and change direction of grinding between grades. When working towards a mirror finish use copious quantities of lubricant such as a light oil.
See separate leaflet "Polishing of Tool Steel" for detailed information on polishing.

TECHNIQUES

Both mechanical and manual techniques may be used. When seeking a mirror finish the use of power tools should be avoided.

MEDIA

Carborundum paper should be used for grinding starting with grades 300 through to 800. When seeking a mirror finish, continue with 1200 grade paper and if necessary followed with 6 micron/ 3 micron diamond paste.

Electrical Discharge Machining (EDM)

Machine settings are similar to those used for steel but may need more power to stabilize. Metal removal rates are 3 to 4 times that of steel necessitating good flushing to avoid arcing.
Copper electrodes give best results and show less wear. Roughing electrodes are rarely required.

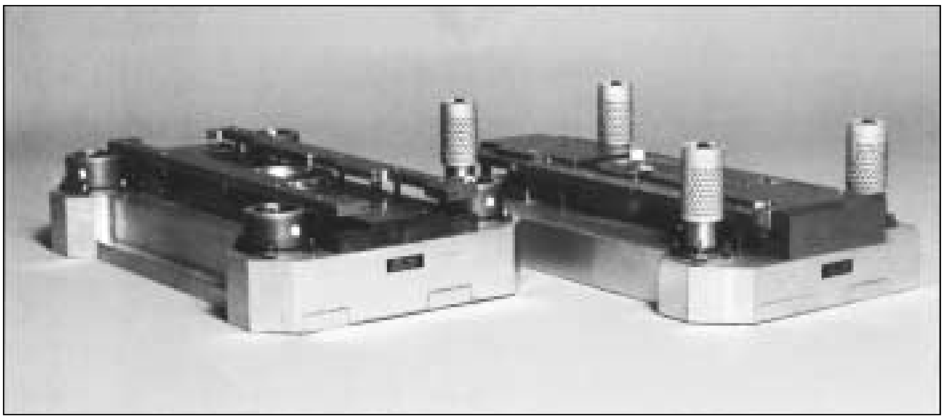
Photo-etching

ALUMEC is perfect for photo-etching thanks to its homogeneous structure.

Surface treatment

HARD ANODISING

ALUMEC can be hard anodised for higher wear resistance, giving a surface hardness equivalent to about 65 HRC in steel. Usual coating thickness is 20–50 µm. Anodising is used to a limited degree in mould cavities due to the difference in expansion of the surface layer relative to the underlying aluminium. This can lead to hairline cracking, spoiling the surface appearance of mouldings. This surface is usually acceptable on non-moulding tool parts, such as slides, wear guides, leader pins and bushes, ejector pins, etc.



ALUMEC is ideal for high-strength, lightweight die-sets.

The anodising will cause dimensional changes in the workpiece, and allowance should, therefore, be made. Increase in dimension is about 50% of the oxide layer thickness. The oxide layer may be impregnated with PTFE to reduce adhesion of the plastic.

HARD CHROME PLATING

Hardness levels up to and equivalent to 80 HRC are possible using processes which have been developed for aluminium alloys. Plated layer thickness is typically 0,1–0,2 mm (0,004" to 0,008").

CHEMICAL NICKEL PLATING

Hardness levels equivalent to 50 HRC are possible. Plated layer thickness is typically 0,03–0,1 mm (0,001"–0,004") whilst adhesion and corrosion resistance are generally superior to a chrome plated finish.

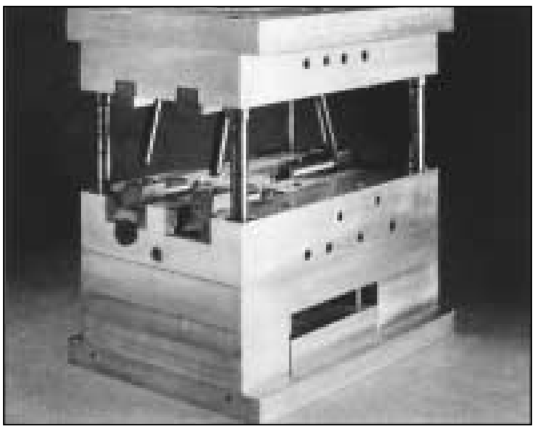
Repair welding

ALUMEC may be repair welded using either Metal Inert Gas (MIG) or Tungsten Inert Gas (TIG) processes, though TIG is not recommended for large scale repairs.

GENERAL GUIDELINES

Equipment: 400 Amps rating, Wire Feed Motor 7,5–10 m/min (25–33 f.p.m.) (compared to 3,7 m/min [12 f.p.m.] for steel).

Welding wire: AA5356 (Al 5% Mg),
AA5556A (Al 5,2% Mg) or
AA5087 (Al 4,5% MgMnZr).
MIG 1,6 mm (0,063 in.) diameter.
TIG 2,4–3,2 mm (0,095–0,126 in.).



ALUMEC tool

Pre-weld preparation: Vertical faces should be machined to an angle and surfaces to be welded, degreased. Oxide layer must then be removed using rotary wire brushing and welding carried out within eight hours.

Pre-heating: Pre-heat to 50–130°C (120–270°F) to offset the chilling effect and high thermal conductivity of *ALUMEC*. Maximum metal temperature during welding should not exceed 200°C (390°F) in order to avoid cracking after welding.

Further information

Contact your nearest Uddeholm representative for more information about aluminium and special steels for tools.