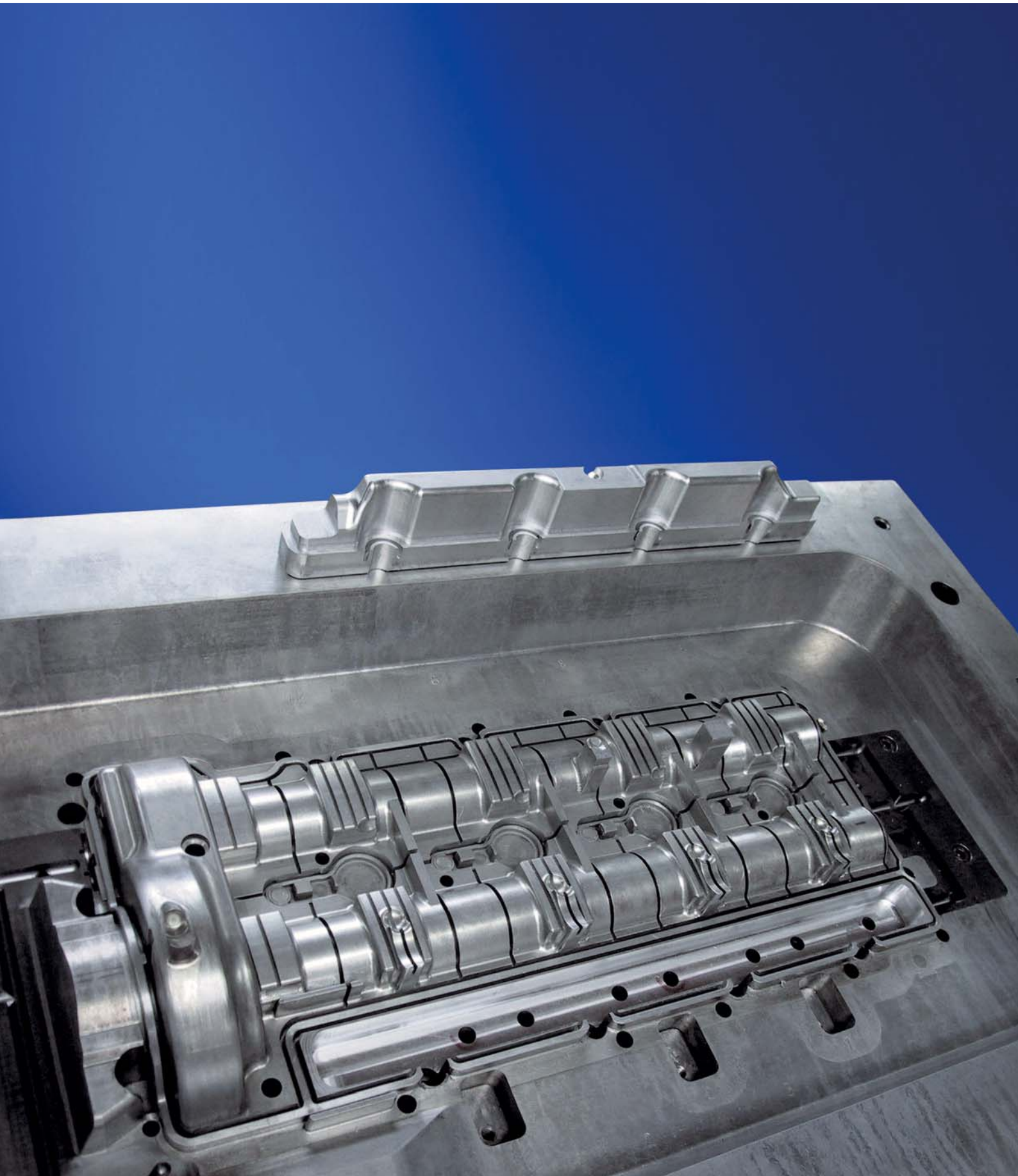
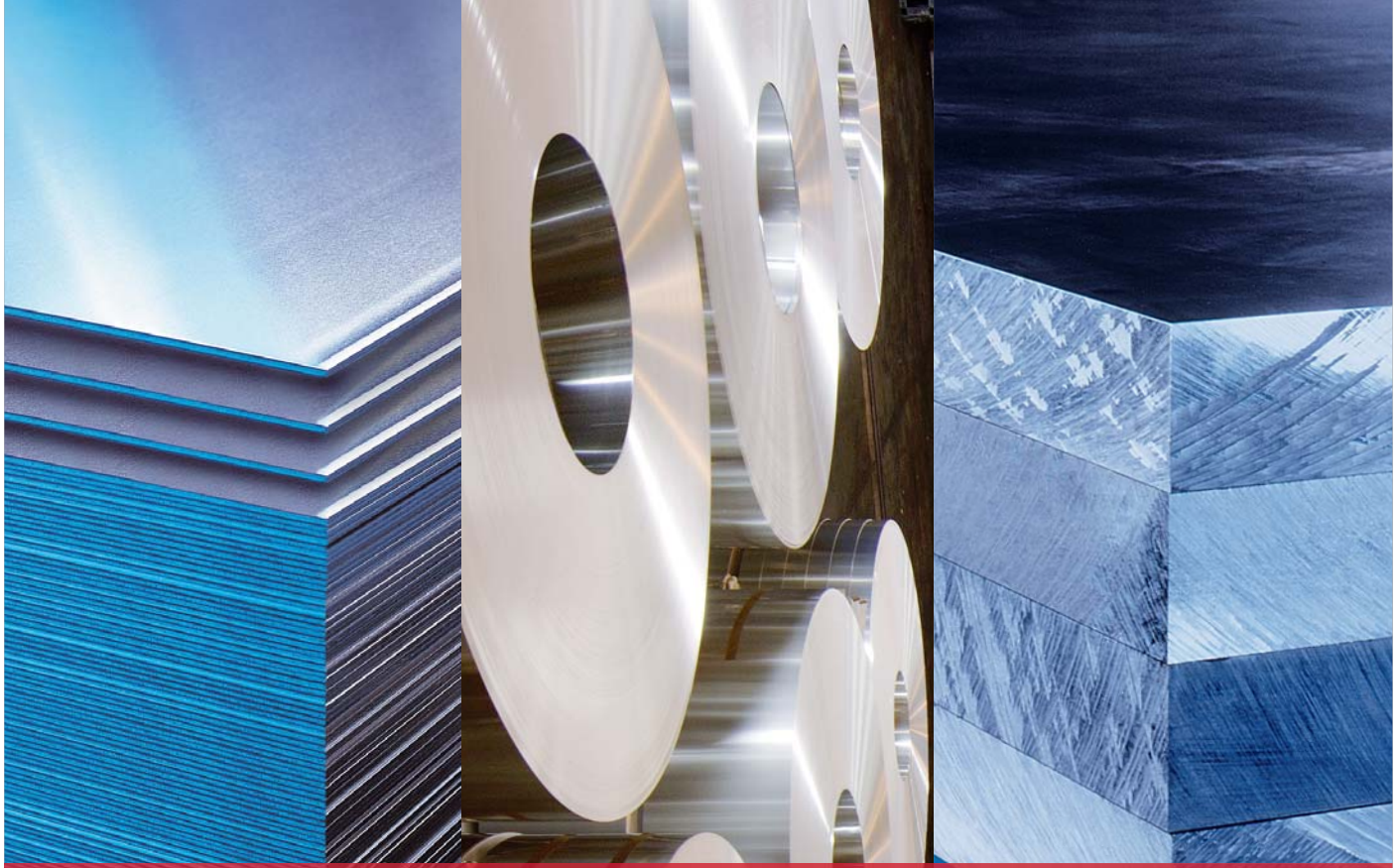
MOLDING & TOOLING ALUMINUM ZHENJIANG CAPABILITIES

Aleris





PRODUCTION FACILITIES IN ZHENJIANG

Aleris is a global leader in aluminum rolled and extruded products, recycled aluminum, and specifications alloy manufacturing with its headquarter in Beachwood Ohio US. Aleris has more than 40 production facilities in North America, Europe and Asia and about 7,000 employees. As an industrial leader, Aleris has a diversified customer portfolio including aerospace , automotive, building & construction, defense, electronics, engineering, heat exchanger, molding & tooling, packaging, shipbuilding, transportation.

ALERIS SUPPLIES HIGH-END PRODUCTS FOR VARIOUS INDUSTRIAL FIELDS AS FOLLOWING:

- Aerospace product-Aleris is one of the largest aluminum material suppliers for the international aerospace industry.. The plate is supplied from Koblenz, Germany and can be produced in Zhenjiang China in the future.
- Commercial &defense plate - thanks to the strict quality control and advanced technology for aerospace products, Aleris is also well-known for commercial and defense plate material. Commercial plate will be supplied in phase 1 of Zhenjiang plant at the end of 2012.
- Auto body sheet - Aleris is one of the largest auto body sheet suppliers in the world. Auto body sheet exerts stringent requirement on machining property and surface quality, which is supplied from Duffel, Belgium.
- Brazing sheet for automotive and industrial heat exchanger - Aleris is one of the largest suppliers of brazing sheet for the automotive industry and industrial heat exchangers.
- Aluminum recycling - Aleris is one of the largest companies in aluminum recycling business in the world.

Thanks to more than 40 years of experience, Aleris with ever increasing quality and technology has become the key aluminum product supplier in diversified industrial fields. For decades, we have always been working hard to apply our experience and technology e.g. in the molding & tooling industry, providing innovative product and material solution for mold producer and user. Nowadays, the molding & tooling alloys of Aleris have been widely used in the production of the parts for automotive, motor bicycle, furniture, home appliance and sports equipment etc.

ADVANTAGES OF ALUMINUM COMPARED TO STEEL

The mold & tool industry is increasingly benefiting from the inherent advantages of aluminum alloys over the traditionally used steel. These advantages are due to the exceptional properties of aluminum materials:

- **EXCELLENT MACHINING PROPERTIES**

  High cutting speed, which on average can be five times faster than that of steel, allows a much shorter processing time. This significantly shortens the lead time between the development of the prototype and mass production of the part, and thus the products can reach the market at a faster pace. Furthermore, excellent machinability of aluminum allows considerably less wear and longer service life of the cutting tools.

- **LOW WEIGHT**

  The low density of aluminum, which is only one third of steel, makes the handling of aluminum products easier and simpler. The lower inertia permits a quicker opening and closing of the tools.

- **HIGH THERMAL CONDUCTIVITY**

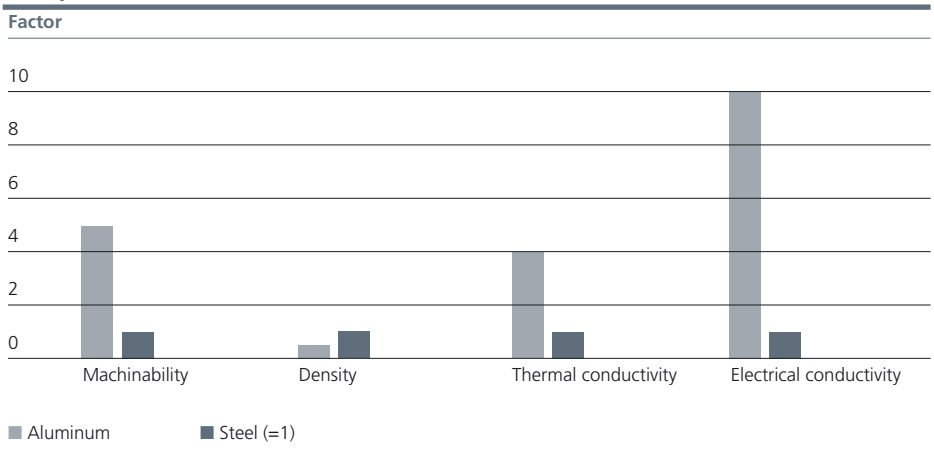
  The four-fold higher thermal conductivity of aluminum significantly reduces the cooling cycles without requiring the installation of complex cooling systems. The superior and uniform heat dissipation of aluminum reduces the formation of internal stresses and the resulting distortion of the finished part.

- **HIGH ELECTRICAL CONDUCTIVITY**

  The ten-fold higher electrical conductivity of aluminum provides the opportunity of machining it by erosion (EDM), four to five times faster than steel. The use of this machining method is also significantly cost effective.

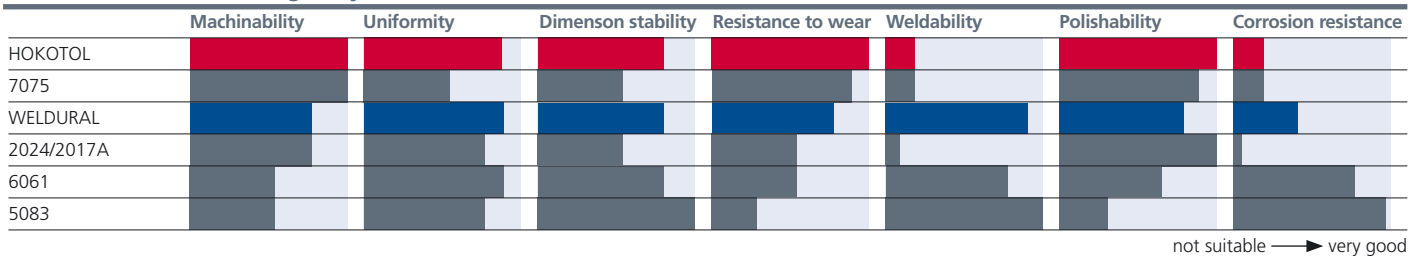
The selection of aluminum alloys should be based on their manufacturing processes and the properties required by their end use application. The graphson in the following pages are intended to help the reader to select an appropriate alloy. These graphs display the chemical compositions, as well as the important physical and mechanical properties of the most frequently used aluminum alloys.

Comparison aluminum with steel



ALLOY COMPARISON

Characteristics of molding alloys



Chemical composition (Composition in weight percent maximum unless shown as a range)

Alloy	Designation	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Zr	Other Each	Total
5083	AlMg4.5Mn	0.40	0.40	0.10	0.40-1.00	4.00-4.90	0.05-0.25	0.20	0.15	-	0.05	0.15
2024	AlCuMg2	0.50	0.50	3.80-4.90	0.30-0.90	1.20-1.80	0.10	0.25	Ti+Zr 0.20	Ti+Zr 0.20	0.05	0.15
WELDURAL	AlCu6.5Mn0.3	0.30	0.40	5.80-6.80	0.20-0.40	0.10	-	0.10	0.02-0.10	0.10-0.25	0.05	0.15
6061	AlMg1SiCu	0.40-0.80	0.70	0.150-0.40	0.15	0.80-1.20	0.04-0.35	0.25	0.15	-	0.05	0.15
6082	AlMgSi1	0.70-1.30	0.50	0.10	0.40-1.00	0.60-1.20	0.05	0.20	0.10	-	0.05	0.15
7020	AlZn4.5Mg1	0.35	0.40	0.20	0.05-0.50	1.00-1.40	0.10-0.35	4.00-5.00	Ti+Zr 0.08-0.25	Ti+Zr 0.08-0.25	0.05	0.15
7075	AlZnMgCu1.5	0.40	0.50	1.20-2.00	0.30	2.10-2.90	0.18-0.28	5.10-6.10	0.20	Ti+Zr 0.25	0.05	0.15
HOKOTOL	AlZnMgCu2.0	0.20	0.30	1.50-2.60	0.15	1.80-2.60	0.10	5.70-7.60	0.06	0.08-0.25	0.05	0.15

Mechanical property of NHT alloy 5083

Temper	Thickness [mm]		Tensile strength R_m [MPa]		Yielding strength $R_{p0.2}$ [MPa]	Elongation A [%]	Brinell hardness [HB]
	>	<	min	max	min		
O/H111	12.5	50.0	270	345	115	15	75
	50.0	80.0	270	345	115	14	73
	80.0	120.0	260		110	12	70
	120.0	200.0	255		105	12	69
	200.0	250.0	250		95	10	69
	250.0	300.0	245		90	9	69
H112	12.5	40.0	275		125	10	75
	40.0	80.0	270		115	10	73
	80.0	120.0	260		110	10	73

Mechanical-physical properties of HT alloys

Alloy			2024	WELDURAL	6061	6082	7020	7075	HOKOTOL
Tensile strength R_m	Plate thickness	100	465	449	343	358	385	533	575
[MPa]	[mm]	200	405	436	335	340	360	492	533
Typical values		300	385	427	341	347	375	501	535
Yielding strength R_m	Plate thickness	100	321	335	318	310	339	462	532
[MPa]	[mm]	200	275	329	305	289	330	426	479
Typical values		300	250	327	322	297	351	434	483
Elongation[%]	Plate thickness	100	16.6	8.9	11.3	10.2	11.4	8.5	7.8
Typical values	[mm]	200	9.3	6.8	10.4	10.1	9.5	7.3	3.6
		300							
Elevat.-temp. strength	24°C		465/321/17	449/335/9	343/318/11	*	*	533/462/9	575/532/8
[MPa]	100°C		434/310/19	414/324/15	290/262/18	*	*	483/448/14	441/421/15
$R_m/R_{p0.2}$/A2	149°C		310/248/17	338/276/17	234/214/20	*	*	214/186/30	221/193/29
1,000h at test	204°C		179/131/27	248/200/20	131/103/28	*	*	110/87/55	117/90/54
temperature without load	260°C		76/62/55	200/159/21	52/35/60	*	*	76/62/65	-
	316°C		52/41/75	48/41/55	32/19/85	*	*	55/45/70	-
	371°C		34/28/100	30/26/75	21/12/85	*	*	41/32/70	-
Brinell hardness [HB]			120	130	95	95	120	150	180
E-modulus [kN/mm²]			72.4	73.8	70	70	71	71	70.3
Density [g/cm³]	20°C		2.77	2.84	2.70	2.70	2.77	2.80	2.83
Thermal conductivity [W/m·K]			120	130	167	170	137	130	154
Coeff. of therm. expansion [10^{-6}/K]	20°C -100°C		22.9	22.5	23.6	23.4	23.1	23.4	23.5
Electrical conductivity [m/Ohm·mm²]	20°C		17	17	25	27	20	19	23

* not available at present

Aluminum mold flowerstand

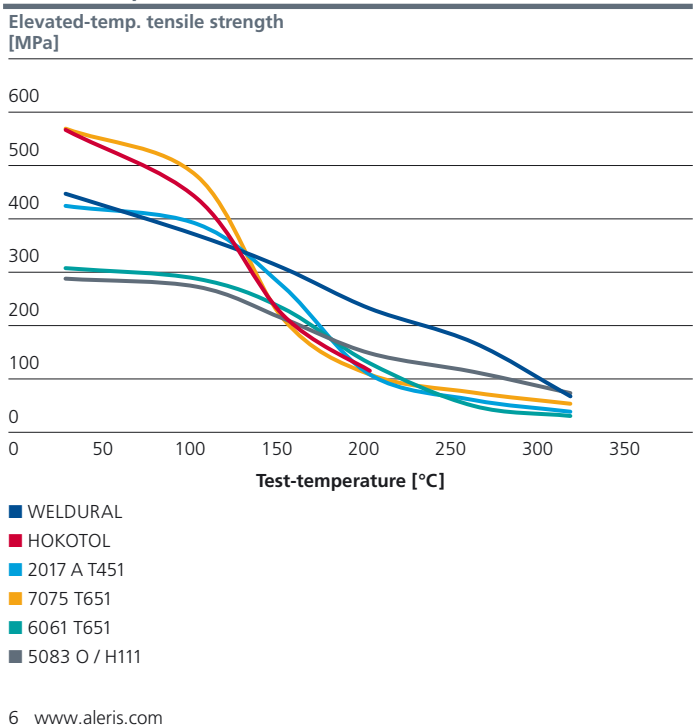
WELDURAL

Under the name of Weldural this alloy was developed as a high quality material for the mold construction industry. According to the classical DIN designation, one would refer to this alloy as AlCu6.5Mg0.3.

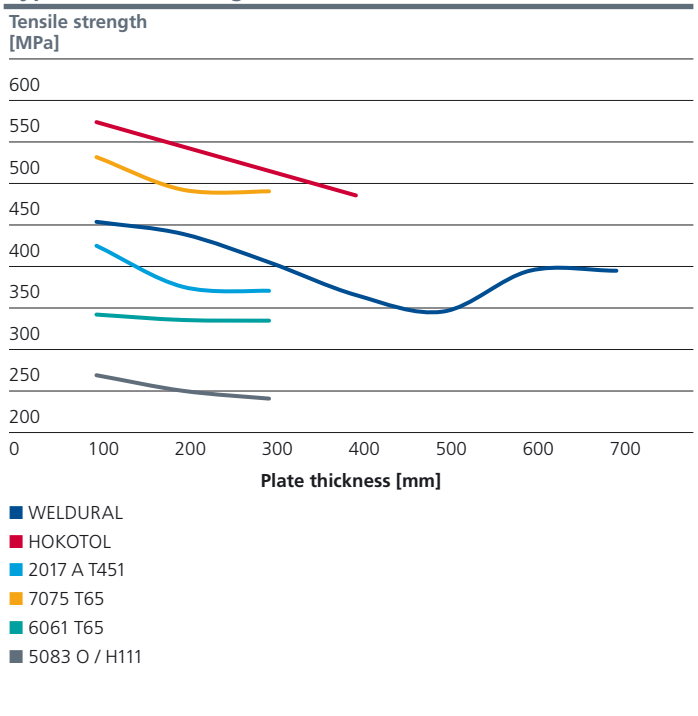
This alloy was designed for excellent weldability and high temperature resistance. Its strength is similar to that of medium to high strength aluminum alloys. Weldural matches 2017A and 7075 alloys not only in machinability, wear resistance, and capability of being polished, but it also offers other advantages. This alloy permanently maintains its relatively high strength at temperatures up to 250°C (482°F).

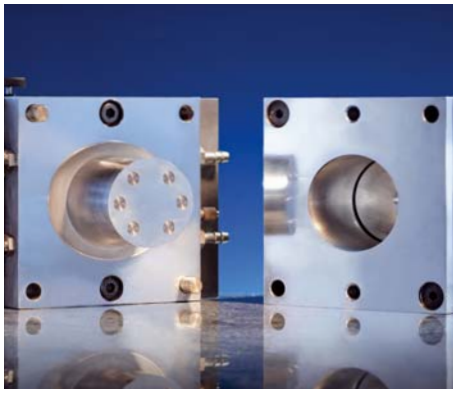
The weldability of Weldural is as good as that of alloy 5083. In contrast to alloy 7075 which typically demonstrates a drop in strength at higher plate thickness, Weldural maintains a relatively high strength with no significant dependence on plate thickness. This characteristic property of Weldural along with its low internal stress level, ensures excellent machinability as well as high dimensional stability.

Typical elevated-temperature tensile strength 10,000 h at test temperature, without load



Typical tensile strength





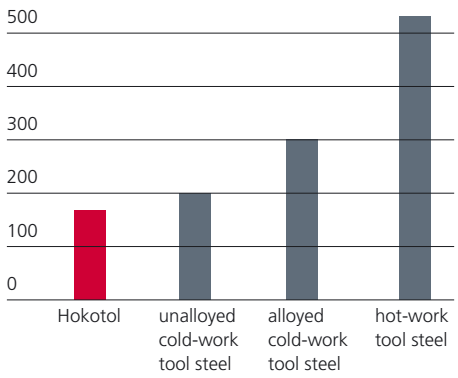
HOKOTOL

As a spin-off from the high strength alloy plate development for the aircraft industry, this alloy was further developed and optimized to satisfy the most demanding applications of the mould construction industry. The resulting mould construction alloy, Hokotol, exhibits very high strength and wear resistance, as well as excellent uniformity of strength properties. These characteristics, offer the mould builder an excellent machinability which remains constant across the entire thickness of the plate, even the thickest ones. Hokotol plates are distinguished by their very high dimensional stability.

Depending on alloy composition high strength aluminum alloys such as Hokotol show generally a very limited weldability. However, repair welding is quite possible when an appropriate welding method such as MIG or TIG is used along with a suitable filler alloy.

Due to higher strength and the inherent advantages of this materials Hokotol is now used for applications which were until recently reserved for low to medium strength steels.

Caption of the Hardness and proof stress for Hokotol, cold- and hot-work tool steel



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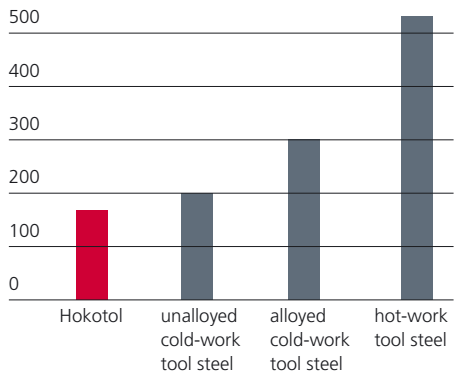
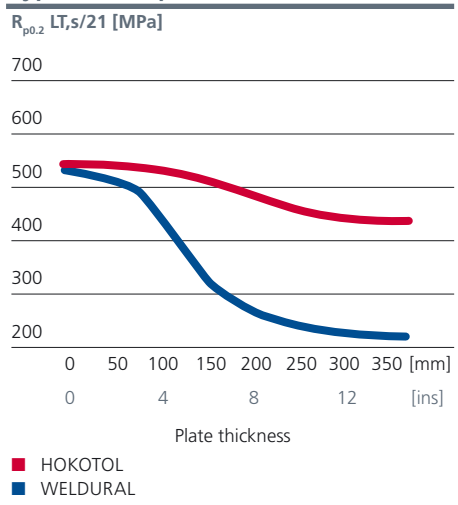
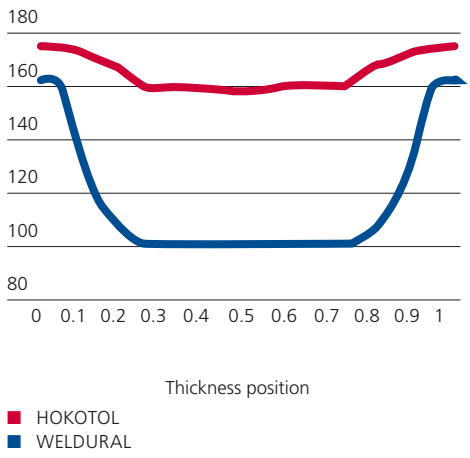


Typical 0.2% proof stress



Hardness across a 300 mm [12"] thick plate



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