ADVANTAGES OF THE PRODUCTION OF ALUMINIUM MOULDS

ALUMINIUM vs STEEL

WEIGHT
Aluminium is one third of steel in terms of weight. The lightness of this material greatly facilitates the handling of large blocks, reducing costs such as transport cost.

MACHINING
Compared to steel, aluminium is an easier material to be machined; therefore, it is possible to improve delivery times when the mould is made of aluminium.

MOULDS FOR THE PRODUCTION OF PLASTIC PARTS
Aluminium is a great conductor and heat sink. The temperature is evacuated from the mould 3 to 4 times faster than in the same steel mould; the cycles reduce up to 25% in time, hence the increase in productivity. For years, every effort has been invested in reducing the cycle time of the production of the plastic part through pressures, materials and rendering of blowing-injection transformation machines. It is in the cooling/heating process of the mould that we can notice great benefits in the use of aluminium moulds.

MACHINING PROCESS	TIME IN % - STEEL	TIME IN % - ALUMINIUM
FACE AND SIDE MILLING	100 %	16 %
DRILLING	100 %	17 %
TOTAL MACHINING TIME	100 % (2h40min)	30 % (40min)
THINNING	100 %	20 %
FINISHED	100 %	24 %

OTHER ADVANTAGES OF THE PRODUCTION OF ALUMINIUM MOULDS

- Excellent (mirrored) polishing
- Production of parts: up to 2 million units
- High thermal conductivity, reducing stabilization times
- Less machine and tool wear
- Lower cost of production

SPECIAL ALLOYS FOR MOULDS

In order to show the advantages of the production of aluminium moulds compared with the production of steel moulds, we present two practical cases, in which the same moulds were produced in 7075 aluminium alloy and in steel 37. In table 1 we can obtain information about the parts and in table 2 the gains/benefits in using the aluminium mould.

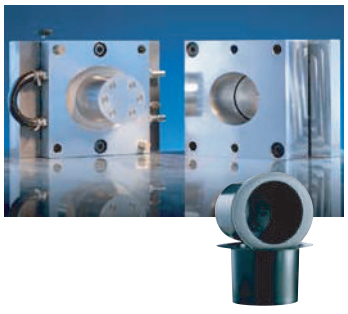
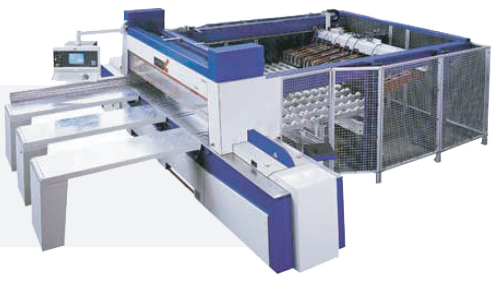


TABLE 1 - INJECTION PROCESS OF PARTS

Weight/part	0.022 KG	0.055 KG
Parts produced so far	700 000	1 000
Type of Plastic	PP	PA6 + 30% GF
Plastic injection temperature	225º C	235º
Mould Temperature	25º - 30º C	80º
Injection Pressure	600 bar	800 bar
Mould Material	Alumínio 7075 e Aço 37	Alumínio 7075 e Aço 37

TABLE 2 - GAINS/BENEFITS IN USING ALUMINIUM MOULD

GAINS/BENEFITS IN USING AN ALUMINIUM COMPOSITE MOULD		
Mould weight	- 42%	- 54%
Price of material	- 47%	- 50%
Mould machining costs	- 33%	- 24%
Production/min	+ 35%	+ 10%
Price/part	- 33%	- 9%



SPECIAL ALLOYS FOR MOULDS

COMPARISON WITH STEEL

HOKOTOL® VS STEEL

PHYSICAL PROPERTIES IN COMPARISON WITH STEEL

Property	Hardness	Density	E-Modulus	Thermal expansion coefficient 20°C - 100°C	Thermal conductivity at room temperature	Electrical conductivity at room temperature
	[HB]	[g/cm³]	[MPa]	[10⁻⁶/K-1]	[W/(m·K)]	[m/Ω · mm²]
HOKOTOL®	180	2.83	73,800	23.5	154	23
Steel 1.2312 (40CrMnMoS8-6)	300	7.85	215,000	12.5	35	10.3
COMPARISON	**1: 1.7**	**1: 2.8**	**1: 3.1**	**1.9 : 1**	**4.4 : 1**	**2.2 : 1**

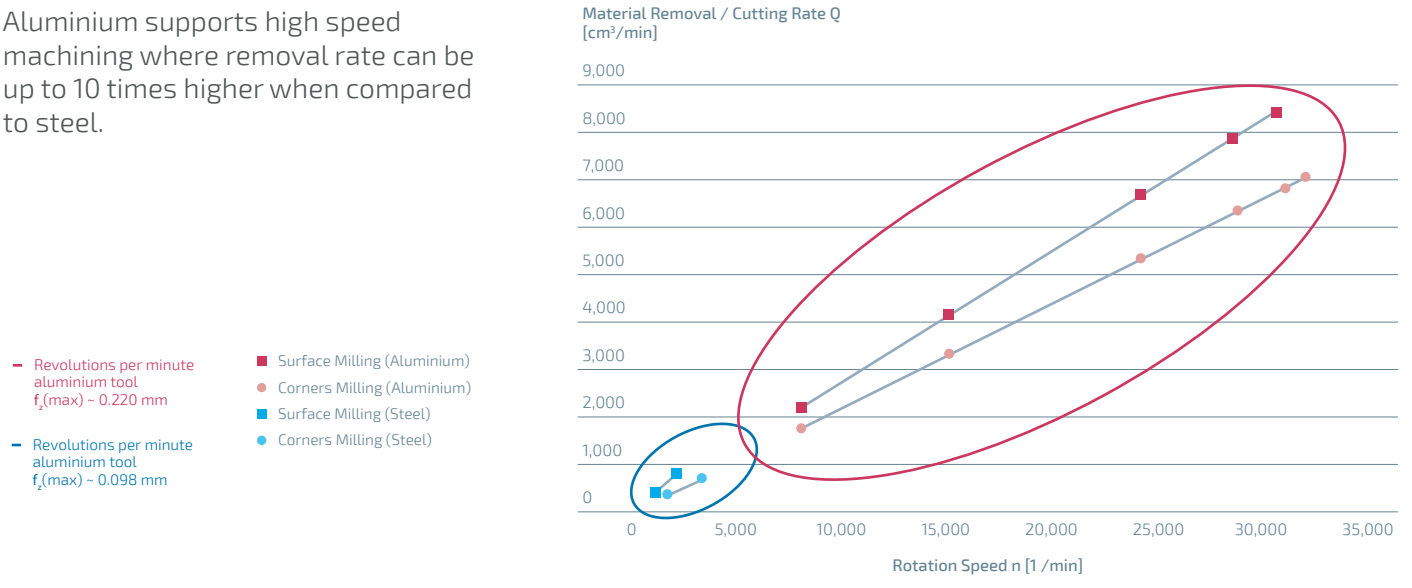
WELDURAL® VS STEEL

PHYSICAL PROPERTIES IN COMPARISON WITH STEEL

Property	Hardness	Density	E-Modulus	Thermal expansion coefficient 20°C - 100°C	Thermal conductivity at room temperature	Electrical conductivity at room temperature
	[HB]	[g/cm³]	[MPa]	[10⁻⁶/K-1]	[W/(m·K)]	[m/Ω · mm²]
WELDURAL®	130	2.84	73,800	22.5	130	17.4
Steel 1.2312 (40CrMnMoS8-6)	300	7.85	215,000	12.5	35	10.3
COMPARISON	**1: 2.3**	**1: 2.8**	**1: 2.9**	**1.9 : 1**	**3.7 : 1**	**1.7 : 1**

MATERIAL REMOVAL/ALUMINIUM CUTTING RATE VS STEEL

Aluminium supports high speed machining where removal rate can be up to 10 times higher when compared to steel.



SPECIAL ALLOYS FOR MOULDS

QUANTITY OF PARTS TO BE INJECTED BY ALUMINIUM QUALITY

MATERIAL	Temp. of Material (ºC)	Temp. of Mould (ºC)	Injection Pressure (bar)	Pressure Maintained (bar)	AW 5083 CAST	CERTAL®/ CERTAL® SPC	ALUMOLD®	HOKOTOL®
Polyethylene BD (PEBD)	160 - 260	20 - 70	500 - 1000		●●	●●●●	●●●●	●●●●
Polyethylene HD (PEHD)	260 - 310	50 - 70	600 - max.	30 - 100%	●●	●●●●	●●●●	●●●●
Polypropylene (PP)	250 - 270	40 - 100	600 - max.	50 - 100%	●●	●●●●	●●●●	●●●●
Polystyrene (PS)	180 - 230	20 - 60	1000 - max.		●●	●●●●	●●●●	●●●●
Polystyrene CHOC (PSC)	< 250	45 - 60			●●	●●●●	●●●●	
SAN	220 - 260	50 - 70	1000 - max.		●	●●●●	●●●●	
ASB	220 - 280	60 - 80	800 - 1400		●	●●●●	●●●●	●●●●
Polyamide 6/6 (PA 6/6)	250 - 290	80 - 90	700 - 1200	30 - 100 %	●	●●●●	●●●●	●●●
Polyamide 6 (PA 6)	240 - 290	80 - 90	800 - 1300	20 - 60 %	●	●●●	●●●	●●●
Polyamide 11 (PA11)	230 - 300	30 - 90	400 - 700		●	●●●	●●●	●●●
POM	180 - 220	50 - 120	800 - 2000	PI	●	●●●	●●●	●●●
PC	270 - 320	80 - 120	800 - 2000	70 %	●	●●●	●●●	●●●●
PETP	260 - 270	140	1200 - 1700		●	●●●	●●●	●●●●
PETP amorphous	270 - 290	70 - 80	1000 - 2000		●●	●●●●	●●●●	●●●●
PBTP	260 - 270	40 - 50	1200 - 1700	60 - 100 %	●●	●●●●	●●●●	
PPO	260 - 300	80 - 110	1000 - 2000	60 - 80 %	●●	●●●●	●●●●	●●●
PVC	170 - 190	50 - 60	1200 - 1400	50 - 80 %	●●	●●●●	●●●●	
PMMA	200 -250	40 - 90	500 - 2000	8	●●	●●●●	●●●●	●●●
PA 6/6 + glass fibers	260 - 290	90 - 120	900 - 1500	40 - 100 %	●●	●●	●●	●●●
PA 6 + glass fibers	240 - 290	90 - 120	1000 - 1500	20 - 60 %	●	●●	●●	●●●
PC + glass fibers	300 - 325	90 - 110	1000 - 200	70 %	●	●●	●●	●●●

●●●● 1,000,000 to 2,000,000 (large S of parts)
●●● 100,000 to 500,000 (mean S. of parts)
●● 100,000 to 50,000 (small S. of parts)
● up to 5,000 parts

ECONOMY - PRODUCTION OF 100,000 PARTS

COSTS	STEEL AISI P20		HOKOTOL®		DIFFERENCE
RAW MATERIAL	76 Kg x 2.5 €/Kg	190 €	26 Kg x 10€/Kg	260 €	+ 70€
MACHINING	100 H. x 30€/H.	3.000€	60 H. x 30€/H.	1.800€	- 1.200€
TOTAL	3.190 €		2.060 €		- 1.130 €

POLISHING

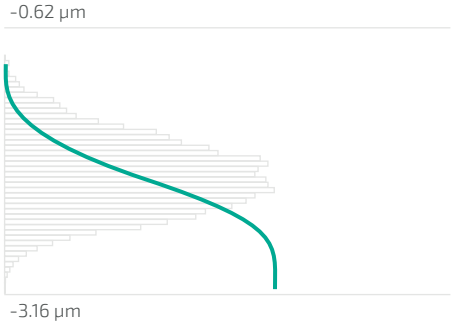
WELDURAL® and HOKOTOL® have excellent mechanical properties in a wide range of applications. An important factor in the production of moulds is the excellent surface quality for components with aesthetic requirements. This can only be achieved if the surface of the mould material is well polished.

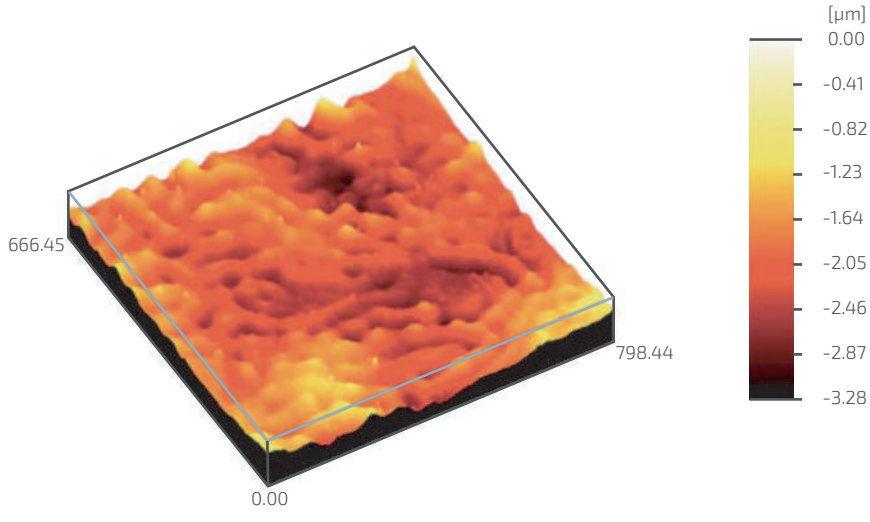
Both HOKOTOL® and WELDURAL® alloys have a good polishing capacity. Below we show the data corresponding to the typical roughness of HOKOTOL® and WELDURAL®.

We can obtain very satisfactory roughness values with standard polishing procedures. This means that both alloys can also be used for other surfaces with different requirements, such as high-gloss surfaces (e.g. headlight tools), textured surfaces (e.g. car interiors), painted surfaces and sheet-shaped composites (for example, outer skin tools). It can be polished across the entire thickness of the plate

HOKOTOL®: It can be polished across the entire thickness of the plate

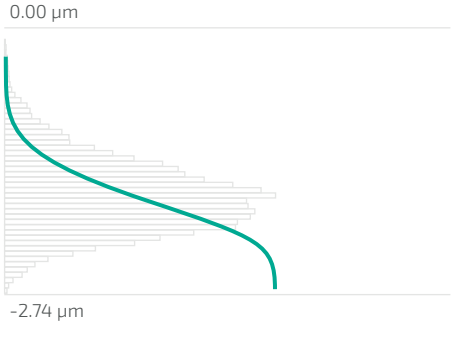
Profile Depth = 2.54 µm
Arithmetic mean deviation of profile roughness [S_a] = 0.21 µm
Quadratic mean deviation of profile roughness [S_q] = 0.26 µm

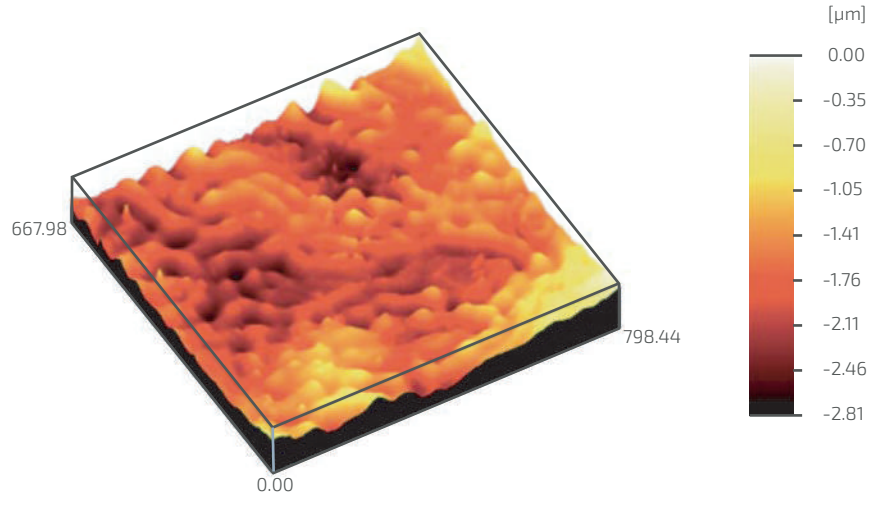




WELDURAL®: Shows good surface polishing

Profile Depth = 2.74 µm
Arithmetic mean deviation of profile roughness [S_a] = 0.21 µm
Quadratic mean deviation of profile roughness [S_q] = 0.26 µm





COATING

Many aluminium alloys, including WELDURAL® and HOKOTOL® can be coated to improve the characteristics of their specific surfaces. The coating material to be used depends on the alloy used. WELDURAL®, for example shows good rigid anodizing results.

Below we show two examples of coating for WELDURAL® and HOKOTOL®.

ADVANTAGES

- Improves mould service time
- Increases the number of production cycles
- Improves corrosion protection
- Improves surface quality

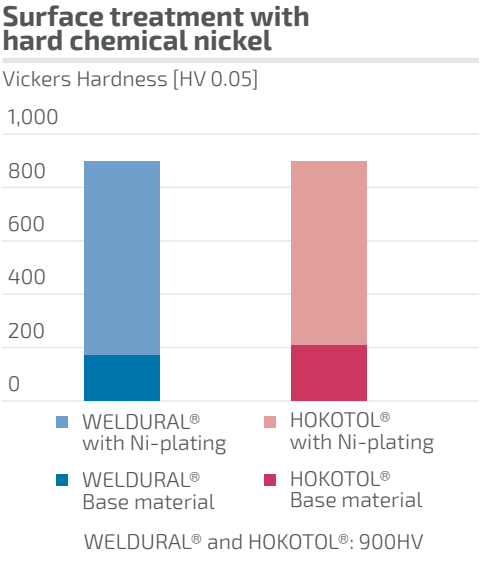
HARD CHEMICAL NICKEL COATING

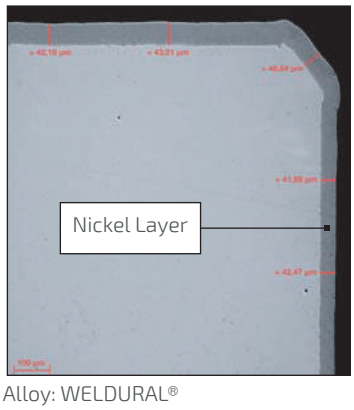
Elemental Nickel is used for protection against wear or corrosion. A very clean surface finish is required for this process.

Visual Appearance:

Explosion Surface
Matt

Polished Surface
Bright

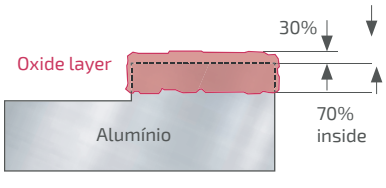


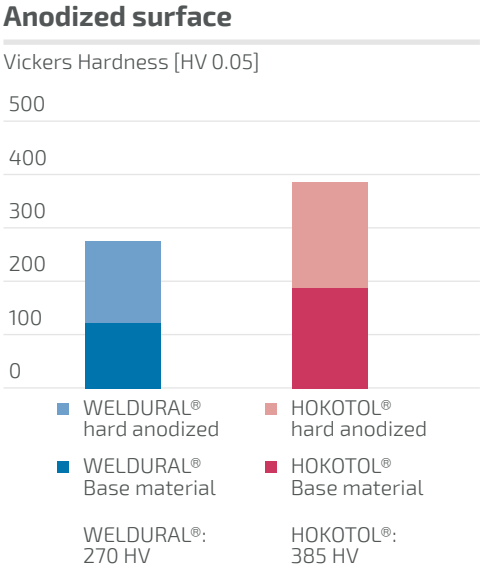


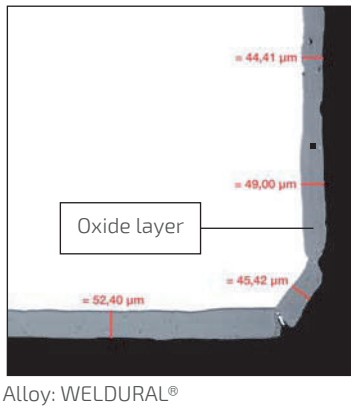
Alloy: WELDURAL®

HARD/INDUSTRIAL ANODIZING

The aluminium oxide layer is increased by the anodizing process to serve as a protective layer for the base metal against corrosion and abrasion. Oxide layers are produced between 0.5 and 150 µm in thickness. During the hard anodizing, the oxide layer can grow on all components exposed surfaces as shown in the figure below.







Alloy: WELDURAL®