RUSAL

MAXIFLOW

6005A MAXIFLOW BILLET
PRODUCT DATA SHEET

Product description

Maxiflow alloys are a new range of High Speed 6000 series extrusion alloys developed by Rusal. Maxiflow alloys offer an optimum combination of extrusion speed and peak aged mechanical properties. 6005A Maxiflow alloy is a heat treatable Al-Mg-Si alloys that is designed for maximum extrusion speed while still meeting high strength requirements such as ASTM B221 and EN 755-2 6005A T6. The maximum extrusion speed of these alloys are comparable to most 6063 alloys with significantly higher mechanical properties. 6005A Maxiflow alloy has good surface finish by most surface finishing treatments, including anodizing. These characteristics are appropriate for architectural end uses as well as a variety of other end uses which may require higher strength than those offered by 6063 alloy but less than 6061 or 6082.

Types of 6005A Maxiflow billets

Type	Feature of each category
Type1	Type 1 was developed for general purpose application and could be suitable for architectural end uses as well as numerous other products including complicated shapes. The alloy was developed for higher speed extrusion including solid and hollow shapes which require excellent surface finish at "as extruded" as well as "after anodizing treatment". Target Silicon content of this alloy is 0.63wt%.


H1
KUBAL Sweden
108118 HO
606012

Recommended condition at extrusion operation

In order to produce desirable extruded products the following conditions are recommended to be carefully controlled and monitored during the extrusion operation.

Billet condition, prior to processing
Billet surface should be clean without any foreign materials, eg. sand, mud and any other substances, for minimizing the cause of surface defects on the extruded shape and for avoiding the damage to the die bearing which will make the die life shorter.

Starting procedure with new die
It is recommended to heat dies to a uniform temperature in the whole die (ideally within +/-5°C). In case of lesser uniformity, extrude the first 1-2 billets with 20ºC higher preheat temperature. Then start the extrusion operation with regular preheat temperature and extrusion speed.

Preheating with Induction heater and Gas type heater

a) Induction heater
Prior to extrusion, billet should be preheated to approximately 430-460ºC for solid shapes and 450-480ºC for hollow shapes with the taper heat of 0.5ºC/cm. (Front temperature should be higher than Back-end). This will allow the extrusion speed to be maximized while still maintaining a stable profile exit temperature.

b) Gas type heater
Under longer preheating at 400ºC or higher, a lot of β-Mg_2Si would be precipitated and would have a negative influence on the mechanical properties and anodizing response. Therefore, preheating times longer than 20 mins in gas type preheater should be avoided with the best efforts.

Container temperature
The container temperature should be maintained in the range of 20-40ºC lower than the billet temperature after preheating since:

a) In case of 0-20ºC lower:
Container wall is not cool enough and billet skin would not be kept in the dead zone/into the butt discard and will tend to flow into the extruded product through the back-end as "Back-end defects".

b) In case of more than 40ºC lower:
Excessive heat loss can occur through the container wall. The press exit temperature of the profile would not increase as expected and there would be a higher risk of the press exit temperature not reaching 510ºC resulting in poor mechanical properties and slower extrusion speed.

Extrusion speed
As maximum extrusion speed is strongly influenced by the die shape, it should be judged/controlled by the surface appearance of the extruded shape and press exit temperature which should be maintained in the appropriate range, see below.

Press exit temperature
Press exit temperature of the profile should be measured/monitored with a thermocouple or a contactless pyrometer for ensuring mechanical properties. Press exit temperature should be kept in the range of 510ºC (min) – 540ºC (preferable), 570ºC (max) with an adequate cooling speed after press exit for achieving good mechanical properties by aging operation. 510ºC at press exit is an

acceptable minimum exit temperature to ensure that all of the Mg-Si goes into solid solution, which will ensure optimum mechanical properties and uniform anodizing response assuming cooling rate after press exit is sufficient. Temperatures lower than 540ºC are best for ensuring the optimum surface finish. Above 570ºC the surface will start to deteriorate and speed cracks may start to appear on sharp edges.

Cooling after Press exit

Adequate cooling speed after press exit is essential to produce good extruded products in terms of mechanical properties, anodizing response, bending characteristics and machinability. Recommended cooling speed is > 3ºC/sec between 500ºC and 200ºC. This cooling speed can be achieved with high volume/low velocity fans along the press run-out table, but water mist cooling might be needed on thicker/hollow section. Faster cooling speeds will improve mechanical properties up to 15ºC/sec above which the strength increases will plateau.

Straightening

Approximately 0.5% of stretching is recommended for straightening, while over 1% of stretching might result in Orange peel surface finish on the product.

Aging treatment

In order to achieve maximum mechanical properties and good anodizing response, a very fine dispersion of β" MgSi should be precipitated after the aging treatment. To achieve this the following process is recommended:

a) Natural aging (keeping As-extruded product at room temperature)

Natural aging for 12-24 hrs, even 4 hrs, is effective to achieve fine/uniform β"-MgSi precipitation during artificial aging in the aging furnace.

b) Artificial aging (aging Extruded shape around 170 - 200ºC for 2 - 8 hrs)

In order to precipitate fine and uniform β" MgSi the as-extruded shape is artificially aged in the aging furnace after natural aging. Generally lower temperatures and longer aging time achieve finer/ more uniform β"-MgSi precipitation, resulting in higher mechanical properties. Higher temperatures and shorter aging times have the opposite effect, as shown in the aging curves attached in the reference. In addition slower heat up time (in excess of 1 hour) will promote higher peak aged strengths.

Typical Mechanical properties for Type 1

Following table shows typical mechanical properties in peak aged condition.

Type	Tensile strength	Yield strength	Elongation	Hardness (Webster“B”)
Type1	290 MPa	260 MPa	10 %	14-15 HW

NOTE:

(1) Hardness conversion table
Although hardness chart is made by Webster “B”, hardness by other scale are shown in the table, attached in the reference.

Recommended procedure and check-points for Anodizing, Bending and Welding process

Following is brief recommendation for Anodizing, Bending and Welding operation.

Anodizing
6005A alloy has a good anodizing response. Press exit temperature and cooling speed need to be maintained in the recommended range. Anodizing treatment should be made as soon as possible after the aging treatment, preferably within 12 hrs. Prior to the Anodizing treatment the shapes should be kept clean, at ambient temperature and in a low humidity area as much as possible. In particular Acidic/Alkaline environments should be carefully avoided.

Bending
In order to obtain good bending characteristics, the following steps are recommended.

a) The recommended timing is to bend the extruded shape within 8 hrs after extrusion, before aging.

b) If the bending has to process over 8 hrs after extrusion, the stabilization with the condition of 165ºC x 2 hrs is recommended to avoid the natural strengthening process. By this procedure, the characteristics of predicable spring back would be obtained at any time.

c) After bending, the shapes can be aged to obtain the maximum mechanical properties by normal artificial aging.

Welding
All extruded shapes can be joined by various welding procedure, eg Arc, Gas and Resistance spot welding. Regarding Filler alloy, 4000 series filler alloy is recommended.

When detailed information is needed, "The Al association welding book" is recommended.

REFERENCE:

1. Trend of Aging curves for Type 1
Typical aging curve for Type 1 are shown in the reference. The condition of aging treatment should be modified by aging chart, according to mechanical properties required by end customers.

2. Hardness conversion chart
Hardness conversion chart of Webster "B", Rockwell "E", Rockwell "F", Vickers Hv is shown in the Table, attached.

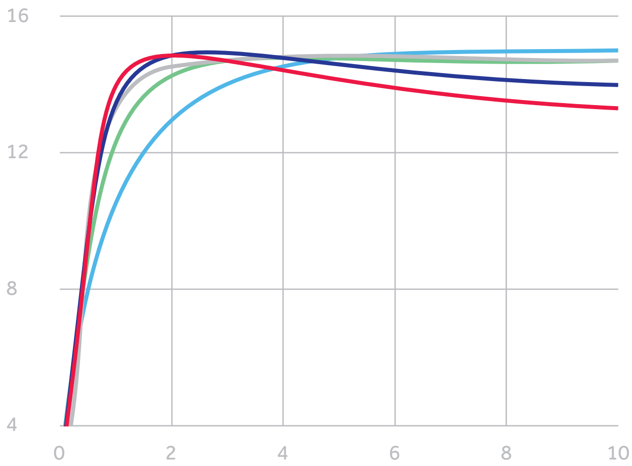
REFERENCE 1:

Mechanical Properties VS Aging condition for 6005A

* Curves presented should be considered representative. Customers should confirm actual aging response in their own process.

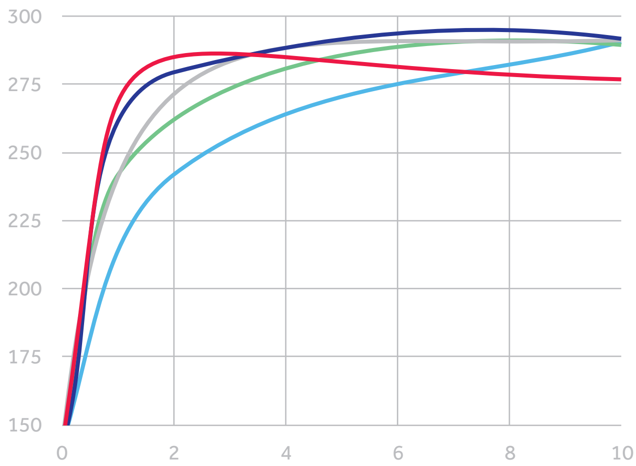
HARDNESS — WEBSTER

Hardness, HW; Holding time, hr



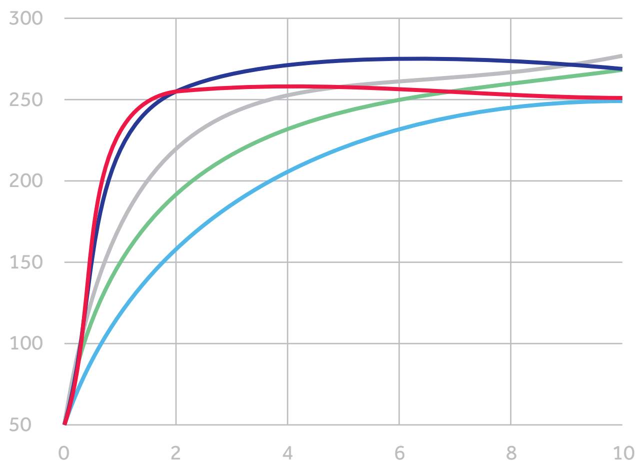
TENSILE STRENGTH

UTS, MPa; Holding time, hr



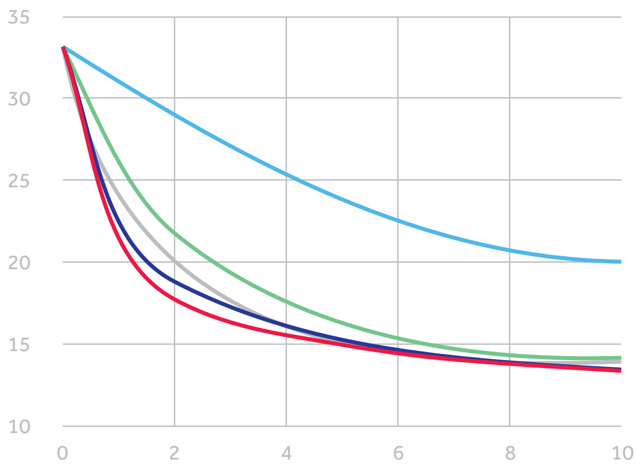
YIELD STRENGTH

YS, MPa; Holding time, hr



ELONGATION

EL, %; Holding time, hr



160 170 180 190 200

REFERENCE 2:

Hardness Conversion Table

WEBSTER HW	ROCKWELL E HRE	ROCKWELL F HRF	VICKERS HV	BRINELL HB
18	101	98.5	131	114
17	97	95	119	106
16	92.5	87.2	108	94
15	88	83	99	82
14	84	78	91	74
13	79.5	74	83	65
12	75	70	78	60
11	71	66	73	55
10	67	62.5	69	53
9	62.5	58	65	
8	58	54	61	
7	54	50	58	
6	49.5	46.5		
5	45			
4	41			

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