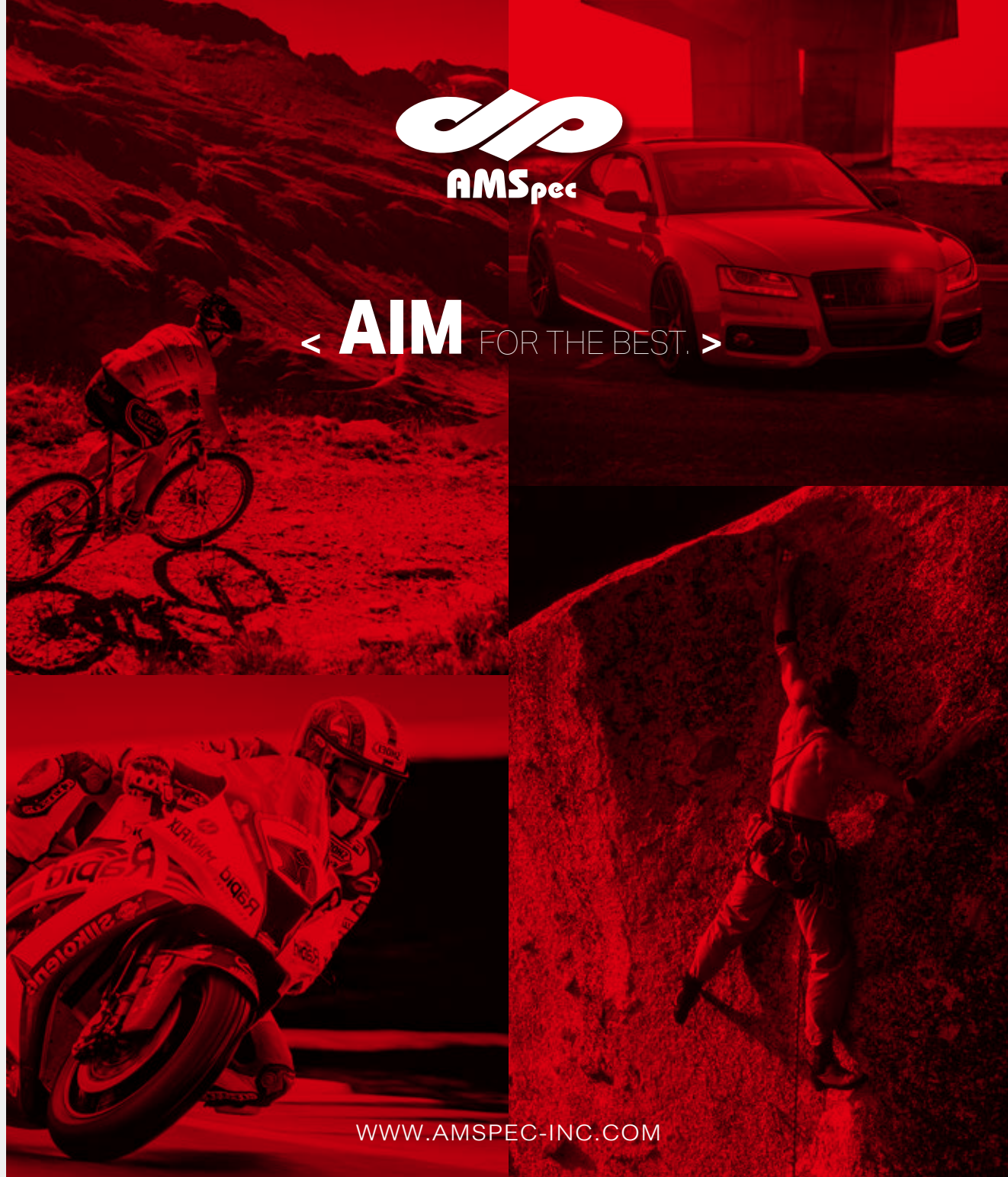




< **AIM** FOR THE BEST. >



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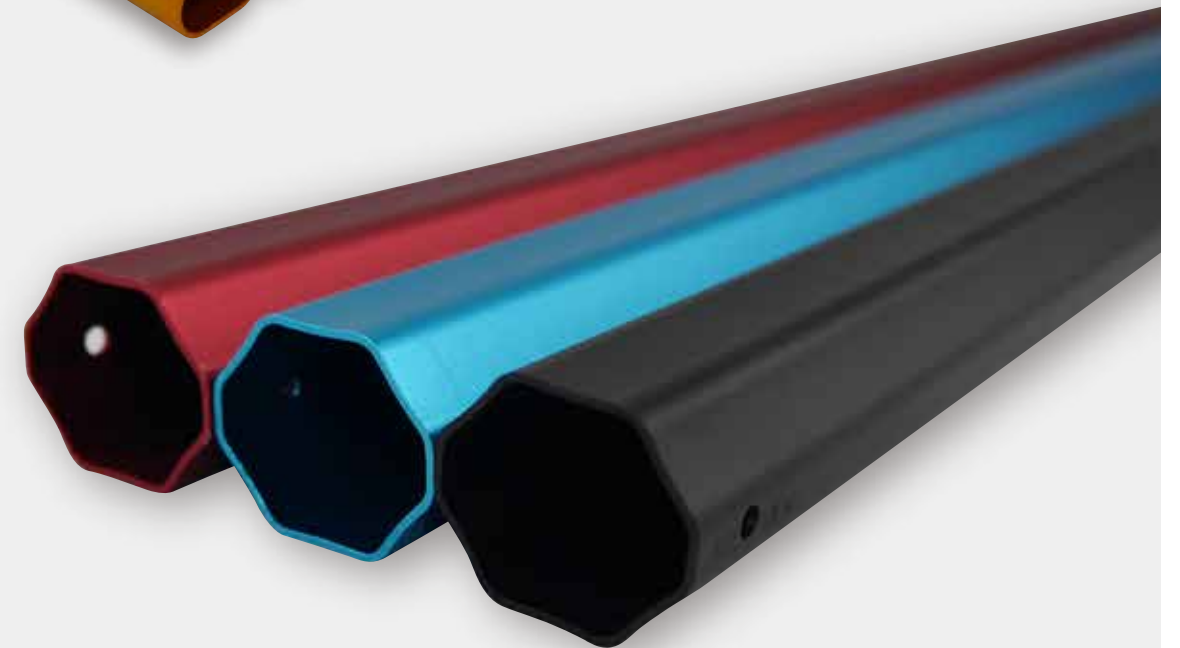
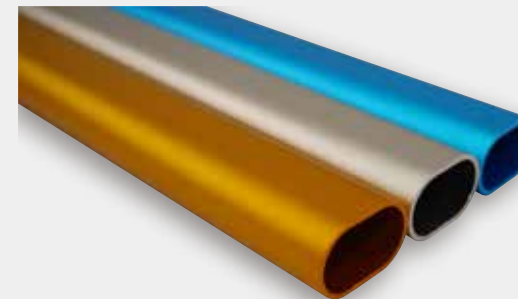
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AIM FOR THE BEST.

AMSpec THE BEST SUPPLIER
OF THE FORMED PRODUCTS
OF ADVANCED ALUMINUM ALLOYS



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PRODUCT & TECHNOLOGY ROADMAP OF AMSPEC

2004-2018

2004

AMSPEC was found by Melissa Wu and Dr. Dick Liu

2006

New General Manager – Dr. Wayne Hong

AZ61 magnesium alloy sheet was tested by ACR electronic and started the mass production.

2008

The head of golf club technique which replaces the Ti-alloy to Al-alloy was award-winning in R&D alliance achievement. (The face insert of King Cobra UFI irons)

2010

Set up 1,500 tons extrusion and hydraulic drawing machines, and 7050 fork tubes passed the fatigue testing by well-known brands.

2012

Successfully finished the development of 7055 class baseball bat for Japan customer.

2013

Project of high strength aluminum alloy and high value technique development phase 1 was finished which sponsored by government, and started the phase 2 on 2018.

2014

Designed patented 6xxx series aluminum alloy to reach strength 7050-T73 level and started the mass production of suspension fork tubes.

2015

Supplied 7005/7020/M7(Sc) T4x bike frame tubes to Europe & America, and run more CAE analysis on structure.

2016

Main supplier with advanced technique for high-end lacrosse shafts which has thinnest thickness and high strength.

Dr. C.T. Chen joined AMSPEC

2017

Successfully developed the high strength aluminum alloy A800Sc bar with TS>760MPa and <5μm fine grain size.

2018

Expand and set up our own 2,000 tons indirect extrusion machine

High Strength Aluminum Alloy Research and Development

Due to the demand for high strength aluminum alloy seamless tubes for bicycle forks and baseball bats, AMSpec's technical team established in 2008 the 7075, 7050-T76 class of seamless tube production technology. This was quickly followed by higher strength and better fracture toughness of 7150, 7055, and other high Zn 7xxx alloys thus achieving industry's highest level of fatigue resistance. We specialize in extrusion, drawing process and heat treatment techniques which aim to reach the top quality in this field.

With high strength Al-Zn-Mg-Cu alloy, such as 7075-T6 alloy, the typical tensile strength is 570MPa, fatigue strength is about 160MPa (23Ksi). According to Figure 1, with different profiles and heat treatment parameters, the strength and fatigue data can change greatly. However, we continue to search for optimal techniques by studying the relationship between mechanical properties and microstructure of high strength alloys.

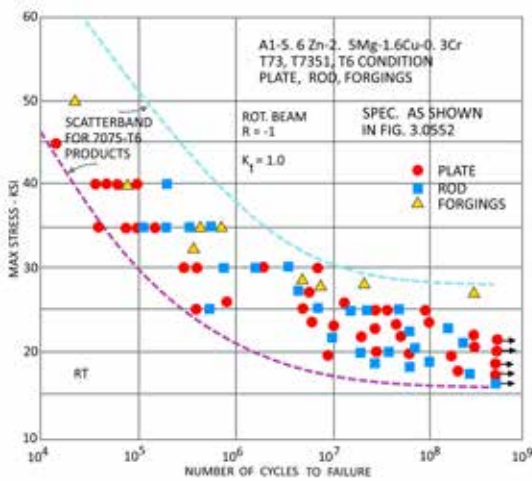


Figure 1 :
atigue behavior of 7075 alloy plate/rod, and
forged under T73, T7351 and T6 conditions.
(Mehr, P. L., et al, "Alcoa Alloy 7075-T73" Alcoa
Green Letter, Aluminum Company of America,
Aug. 1965)



Figure 2 :
Typical microstructure of as-cast & extruded 7050 alloy.

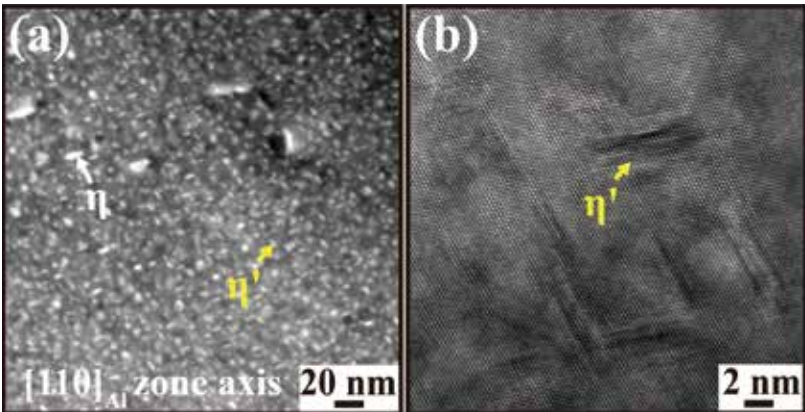


Figure 3: Working with the department of materials science and engineering of the National Taiwan University, we are studying the microstructure of the 7xxx series high strength aluminum alloy.

We have greatly improved bending deformation and impact resistance in 7055 and 7068 class material. So far, our mass production of these products exceeds 100 tons. The following 7250, A600Sc, A800Sc alloys optimized by AMSpec have reached tensile strengths of 700MPa or above. We make these high strength aluminum alloys with highly purified casting techniques along with the addition of micro-refined elements (such as scandium) and supersaturated alloy modification techniques to achieve the target of ultra-high strength.

In plastic deformation processing technology, we mainly use AMSpec's extrusion mechanisms to achieve excellent results with our multi-pass extrusion process capability SPD (Severe Plastic Deformation). With the development of especially fine crystalline materials and heat treatment technology, material characteristics can far surpass the limits of traditional aluminum alloys.

Table 1 : Typical properties of high strength Al-Zn-Mg-Cu

Alloy-Temper	Dimension	Static Mechanical Property			Dynamic Mechanical Property	EXCO Rating (ASTM G34)
		TS (MPa)	TS (MPa)	EI (%)		
7075- T6	ASTM B241 Tube <6.3mm wall thickness	>540	>485	>7	Fatigue Strength 160 MPa	ED
7050-T76	ASM Metal Handbook, Typical properties	550	490	11		EB
7150-T7x	Alcoa Aerospace Technical Fact Sheet	>579	>534	>8		EB
7055-T7x	Alcoa Technical Data 25.4mm thickness plate	>669	>655	>11		EB
7250-T7x	AMSpec OD 32mm bar, Typical Properties	720	680	12		EB
A600-T7x		735	700	12	Fatigue Strength >200 MPa	EB
A800-T7x		752	716	12		EB

Weldable Aluminum Alloy and Profile Technique

Weldable aluminum alloy

With traditional high strength alloys of Al-Zn-Mg-Cu (7050, etc.), peak tensile strength can reach 600MPa or higher but unfortunately its weldability is only Grade C (classification in the order from A to D; Grade C means limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties). Since welding of aluminum alloy bicycle frames usually involves either the TIG or MIG process, this poor weldability problem limits the use of lightweight high strength aluminum alloys in bicycle frames.

For traditional bicycle frames made with 6061 and 7005 aluminum alloy tubes with typical tensile strengths of 310MPa and 350MPa respectively, the weldability by TIG welding is Grade A. The AMSpec team has accepted numerous commissions from famous bicycle frame factories for many years, seeking to enhance the 6xxx series frame tube to Duralumin 2xxx series aluminum alloy strength along with Grade A weldability. As shown in the table below, 2014 aluminum alloy with tensile strengths of 450MPa and yield strengths of 386MPa are target values of bicycle frame tubes. Improved from 6xxx series aluminum alloy, 6xxx-Sc alloy is superior to M6 (6069). The latter has been the main material of most top bike frames for more than 10 years but the strength is still low. Improvements to 7xxx Alloy, 7xxx-Sc (M7) are highly regarded but the weldability needs to be further improved and the price of Al-Sc series alloys is still very high.

Table 2:
High-end bicycle frame alloy tube compare to the typical duralumin aluminum alloy.

Alloy	Static Mechanical Property			
	TS(MPa)	YS(MPa)	El(%)	Weldability
M6(6069)	403	369	9.8	A
2014-T6	450	386	8	D
6xxx-Sc	446	390	11	A
7xxx-Sc(M7)	490-520	450-480	11-12	B

AMSpec has just created a high strength aluminum alloy tube with a tensile strength of 7050 (TS 600MPa) for the construction of bicycle frames. We have also invented a material which is suitable for welding at the tube ends but features high strength aluminum alloy characteristics elsewhere. To illustrate with 7x50 / DB (Diffusion Bonding) tube first, note that at the other end of the tube as shown below, the weldability has reached Grade A without compromising the high strength of the bimetallic tube material.

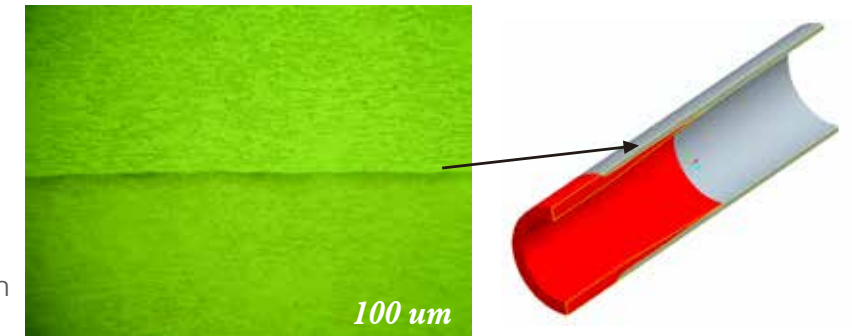


Figure 4: AMSpec's patented technique in 7x50/DB(Diffusion Bonding) tube.

We have achieved another very special product breakthrough by refining 6xxx series aluminum alloy down to a grain size below 10 μ m. In addition to maintaining Grade A weldability, fatigue strength is significantly improved and the overall result is a product with characteristics close to 6xxx series with Sc and Duralumin alloy.

Aluminum Alloy Profiles

The aim of our continuing efforts is to develop extrusion technology that can modify and improve the extrusion parameters to achieve uniform microstructure of extruded profiles when subject to isothermal extrusion.

Coupled with the appropriate mold design to improve both dimensional precision and strength after heat treatment, this is the main reason for our progress in this area. Current product development tends toward small size and thin profile products; typical examples are 3003 MPE (Micro Port Extrusion) and 6xxx series bicycle rims.

Profiles of Bicycle Rim :

A high quality bicycle rim is easier to fabricate when employing isothermal extrusion with optimized spray quenching and stretching techniques. If higher strength and thinner profiles are required, the parameters become more stringent. Thus we need to design more suitable techniques for the extrusion of high strength 6xxx series aluminum alloy to overcome this problem.



MPE (Micro Port Extrusion) :

An important industrial application is the production of MPE tubes or porous heat dissipation plate with 3003 or 6063 aluminum alloys that have good extrusion capability. Due to the need for rapid and dedicated production capacity and equipment, a small amount and special requirements of the product is very suitable for development.

FOR THE BEST.

Aluminum Alloy Products and Manufacture Development Capability

AMSpec has accepted many customers' projects to develop new products and to improve production efficiency. We have managed to achieve a uniformly high level of customer satisfaction. Due to the demand and the manpower required, AMSpec often submits proposals to gain government funding and to work with some well-known universities to conduct further in-depth development.

For general project development, we will often use reverse engineering analysis, failure analysis, CAE analysis, and specific alloy design to satisfy our customer's requirement.

-We have excellent capability in reverse engineering analysis because our team has extensive experiences in material analysis and process technology. We are entirely capable of designing based on our customers' process plans and on a precise understanding of our customer's requirements. In addition, we are able to identify faults or drawbacks of other products and to design improved process methods without violating intellectual property rights.

-We can readily identify causes of damage of a particular product by proper sample selection, metallographic material analysis and testing of mechanical and chemical properties. We can pinpoint with a high probability of success the necessary steps to assist customers in improving their design and process techniques.

-Customer specifications for extreme lightweight and high strength properties for products such as bicycle frames and many other types of sporting goods can often be met only by modifying standard alloys or in some cases, designing an entirely new alloy. One successful example of AMSpec's work in this field is using 6xxx series aluminum alloy to replace 2014-T4 or 7050-T73. The newly developed 6xxx series aluminum alloy meets all specifications for mechanical properties but far exceeds other alloys in corrosion resistance and production yield.

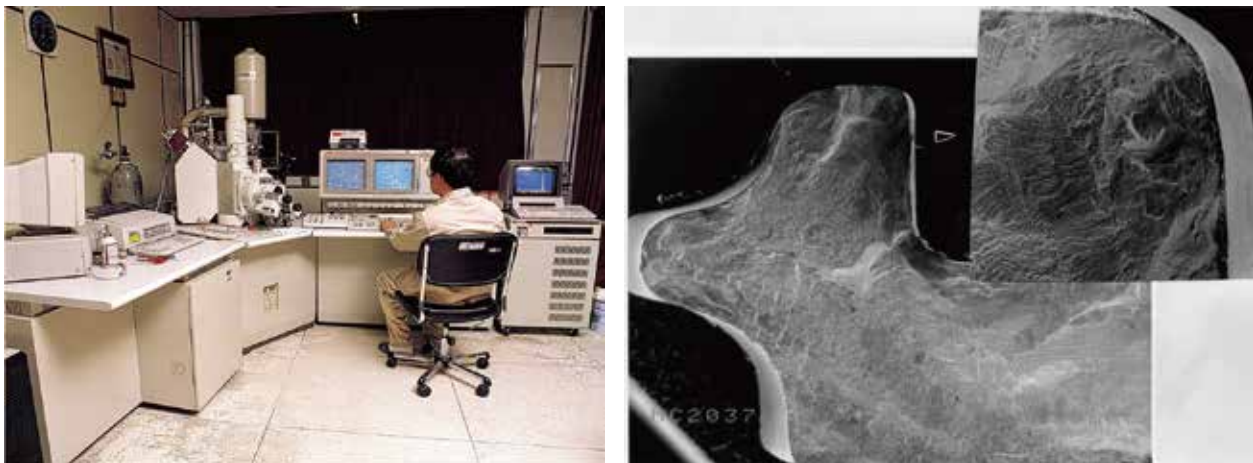
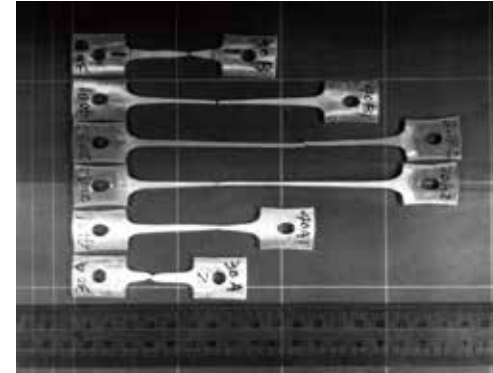
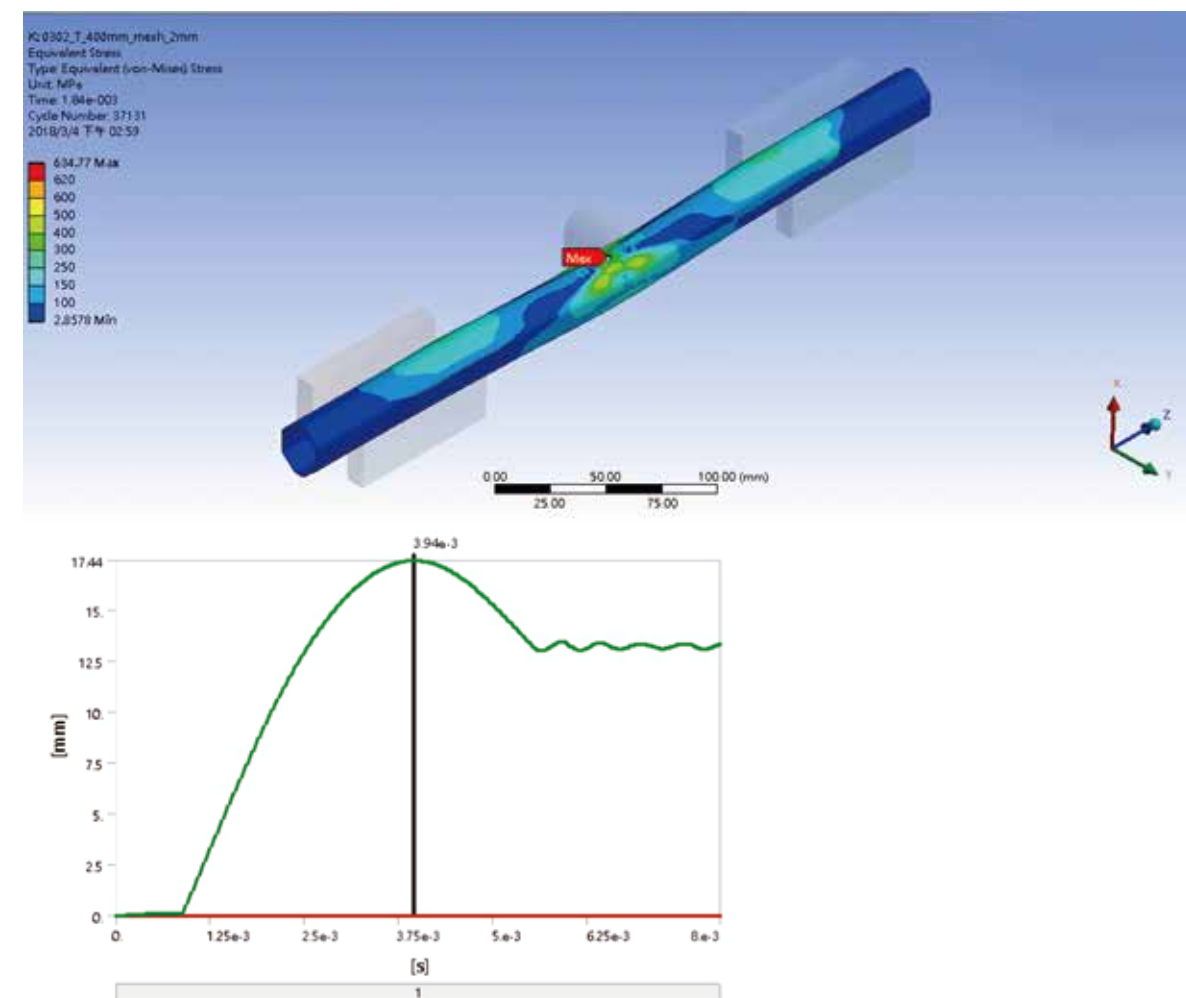


Figure 7:
Example of SEM fracture surface analysis by AMSpec



In one case, we developed a special high strength, impact and toughness aluminum alloy for a customer. It is 5xxx+Sc, elongated under a high temperature condition (200~500°C). The elongation can reach a very high 1000%, if processed at 500°C and 10-2 strain rate.



Another example of success involved the impact testing of a lacrosse shaft. We used CAE (Computer Aided Engineering) to run a drop hammer test. The maximum impact happened at 0.0038 second, the max stress was 634.77MPa, and the maximum deflection 17.44mm. The stress exceeded the tensile stress from tensile testing which will cause permanent deformation of the tube. The deformation is 13.24mm which is consistent with the results of actual drop hammer testing.

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Development of Aluminum Seamless Tube Process Equipment and Its Manufacture

With the aim of providing particular products and properties, AMSpec has combined the techniques of forging, casting, NC (numerical control) processing, hydraulic, and control systems. Guided by our specialists, we manufactured our own 2,000 tons aluminum seamless tube extrusion equipment. This not only increases our production capacity but also allows us to use SPD (Severe Plastic Deformation) techniques to improve material properties and provide more precise dimensional control.

We continue to improve manufacture process parameters step by step and by establishing secondary process equipment methods and techniques after the extrusion process, we expect to achieve significant breakthroughs in high strength aluminum alloy thin wall tube drawing, high precision diameter formation and surface roughness processing.

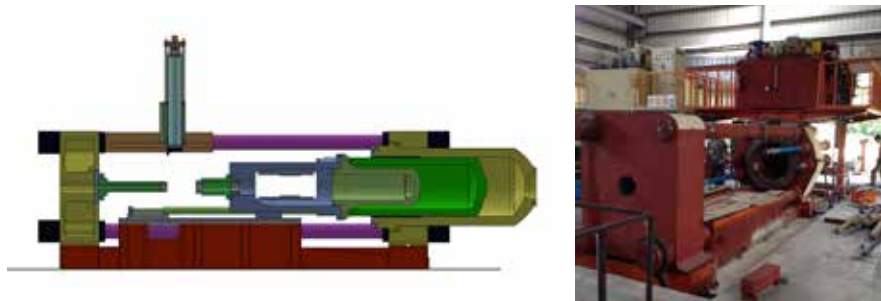


Figure 8:
Design of 2,000 tons extrusion
machine & mechanical and
hydraulic parts assembly

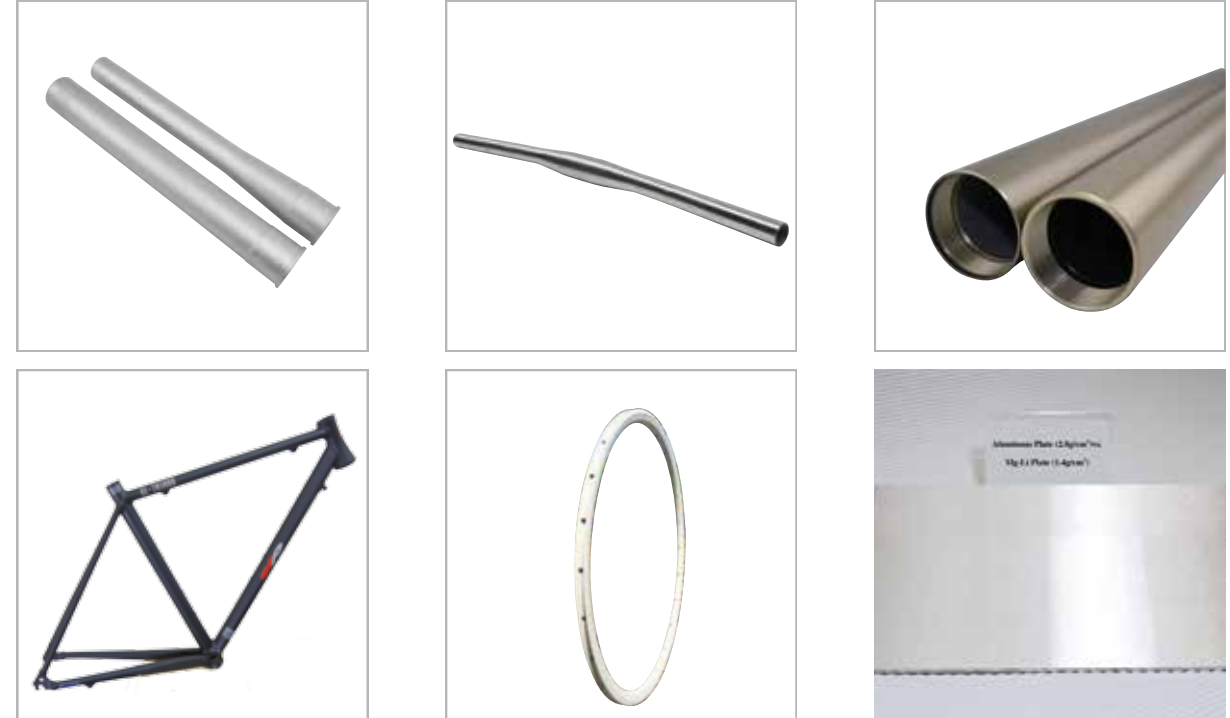


Figure 9:
Wooden mold, casting steel bar for
forging, and NC processing.

The philosophies of developing the extrusion and 2nd process equipment are based on the alloy microstructure and characteristic during the processes, for instance, the seamless tube extrusion press requires isothermal, multiple and high extrusion ratio (SPD process) and precise dimension production. And the new drawing equipment not only remains the high accuracy production, but also uses the CAE analysis to create particular manufacture methods based on different alloys and profiles.

Our Products

High strength bicycle components



High strength outdoor sporting equipments



Aluminum alloy tubes and profiles

