UACJ

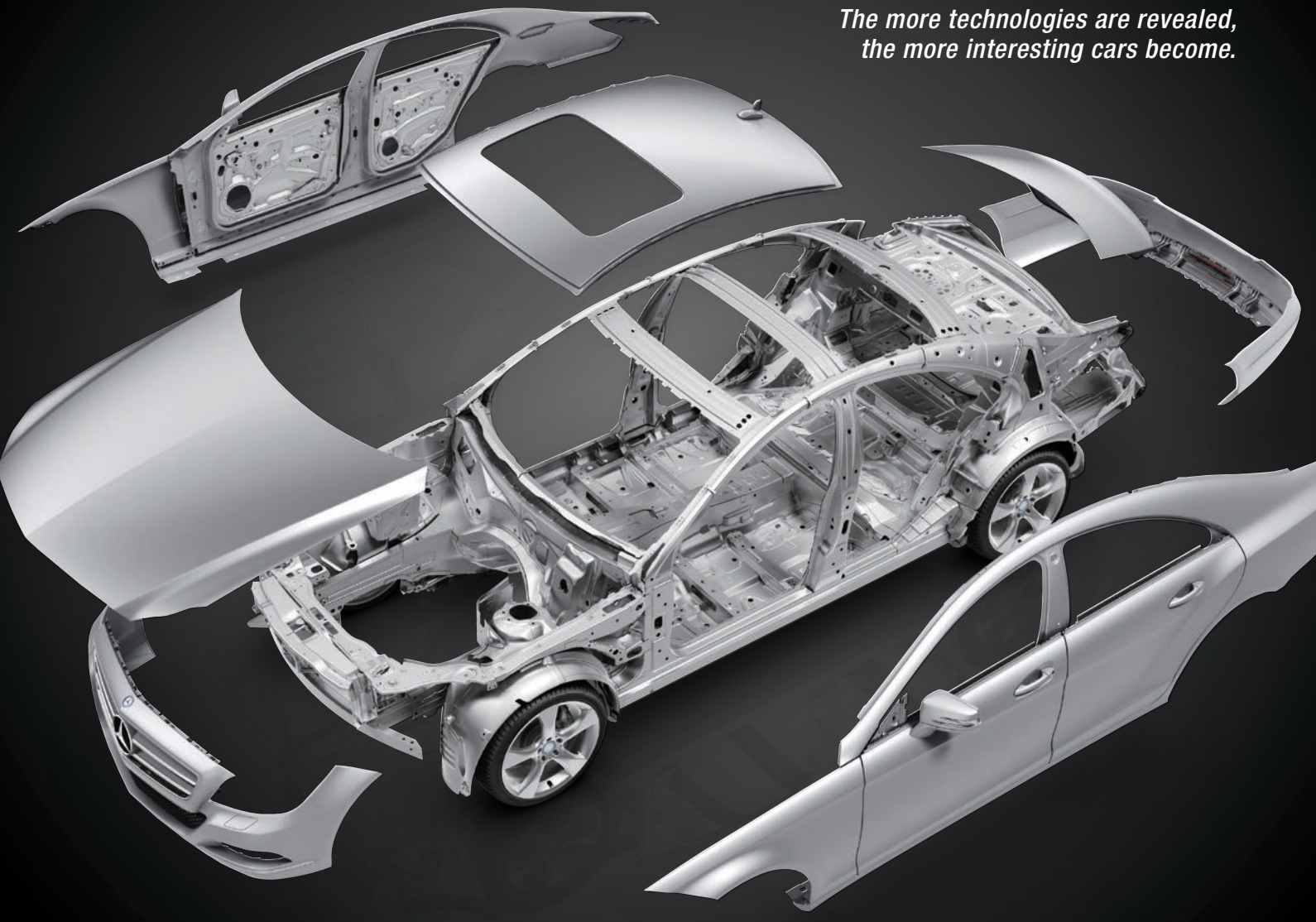
English Version

ATZ Extra Issue

Motor Fan illustrated

Special Edition

The more technologies are revealed, the more interesting cars become.



Special Feature **Aluminium Technology 3**

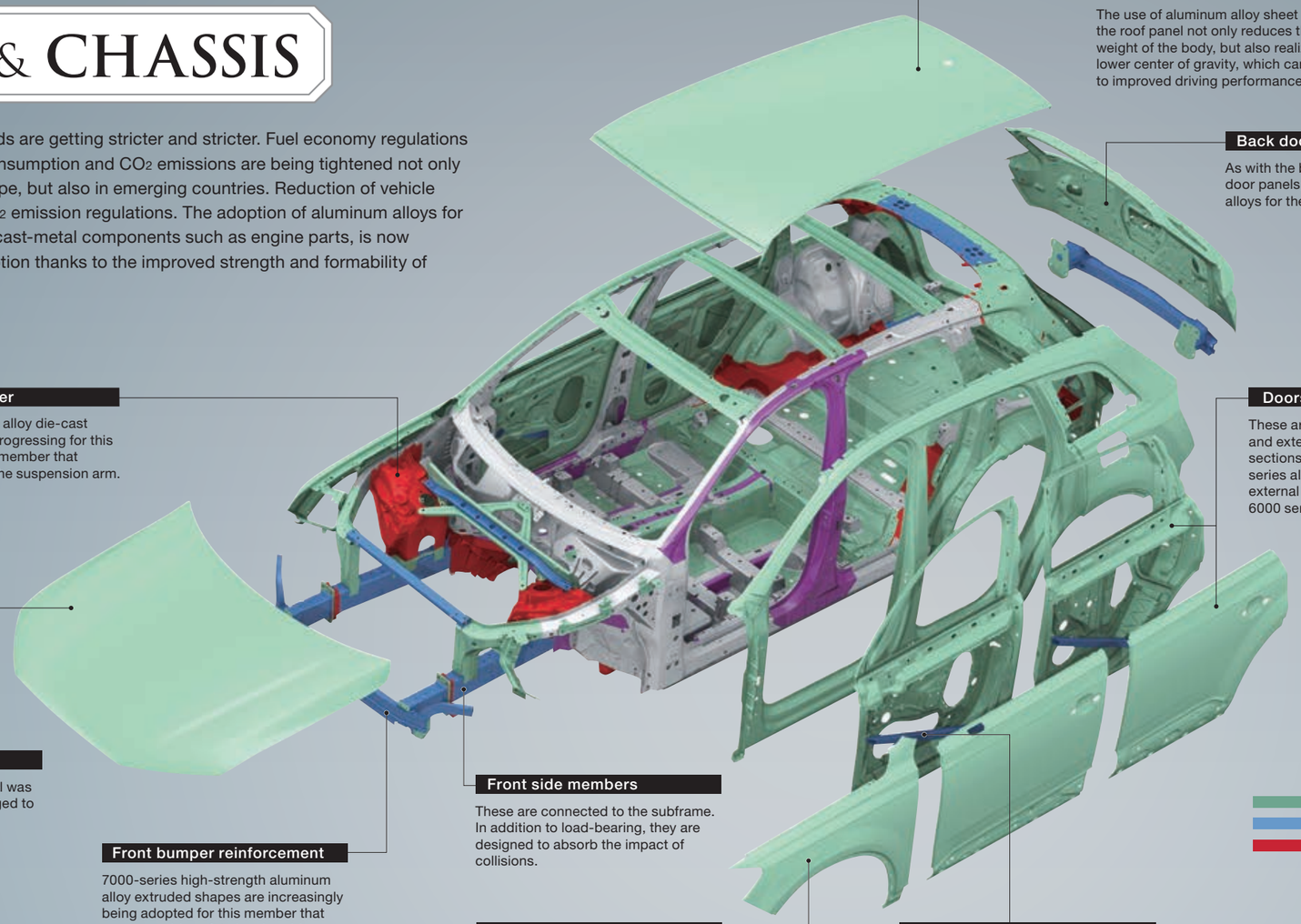
ALUMINIUM

Smart Developments

Use of aluminum alloys in automobiles ❶

BODY & CHASSIS

Global fuel efficiency standards are getting stricter and stricter. Fuel economy regulations intended to reduce energy consumption and CO_2 emissions are being tightened not only in Japan, the U.S.A. and Europe, but also in emerging countries. Reduction of vehicle weight is a key element of CO_2 emission regulations. The adoption of aluminum alloys for automobiles that began with cast-metal components such as engine parts, is now progressing to full-scale adoption thanks to the improved strength and formability of wrought aluminum alloys.



Roof panel

The use of aluminum alloy sheet for the roof panel not only reduces the weight of the body, but also realizes a lower center of gravity, which can lead to improved driving performance.

Back door & trunk lid

As with the bonnet, front fenders and door panels, the use of aluminum alloys for these parts is increasing.

Suspension tower

The use of aluminum alloy die-cast products has been progressing for this important structural member that supports the top of the suspension arm.

Doors

These are constructed from internal and external sections. The internal sections are often made from 5000 series aluminum alloys, while the external sections are often made from 6000 series aluminum alloy sheet.

Bonnet

The body's largest exterior panel was one of the first parts to be changed to aluminum, and this has led to a considerable weight reduction.

Front bumper reinforcement

7000-series high-strength aluminum alloy extruded shapes are increasingly being adopted for this member that secures cabin safety by absorbing collision energy.

Front side members

These are connected to the subframe. In addition to load-bearing, they are designed to absorb the impact of collisions.

Front fenders

These were among the earliest parts to be created from aluminum sheet after the bonnet. Their area is smaller, but they involve complicated designs, such as large curves.

Side impact beams

Located inside the doors to absorb side collision impact, these parts require high strength to ensure shock-resistance.

Aluminum alloy sheet
Aluminum extruded shapes
Aluminum cast products

› Aluminum alloy sheet

The specific gravity of aluminum is only 2.7, approximately one-third of that of steel. It's widely used for industrial products because of its great strength per unit of weight, along with its superior formability and corrosion resistance and recyclability. In the automobile field, it has been increasingly adopted since 2000 as a material for body panels. Even the current models using multi-material bodies employ mostly aluminum alloy sheet for their body panels.

› Aluminum extruded shapes

Intricately shaped cross-sections can be formed using the extrusion process. This makes aluminum extruded shapes optimal for the production of parts with a constant cross-section and long length, such as bumper beams. It's now common to find space-frame structures made of aluminum extruded shapes in large SUVs and electric vehicles. Moreover, extruded shapes with simple cross-sections can be processed 2- or 3-dimensionally for sub-frames and braces.

› Aluminum cast products

Typical examples of automobile parts that are now made from aluminum cast products are cylinder blocks, transmission cases and wheels. They are also ideal for members connecting the body and chassis, such as in the area connecting the suspension tower with the cross members and front side members.

All-aluminum alloy monocoque RENAULT **ALPINE A110**

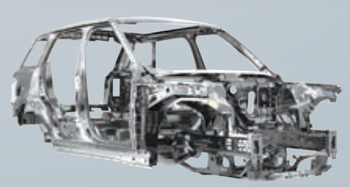
The weight of the new Alpine A110 is as low as 1,103 kilograms thanks to the all-aluminum alloy platform and upper body structure.

Multi-material monocoque BMW **7series**

Adoption of a multi-material body structure for the new BMW 7Series has realized a weight reduction of around 130 kilograms. Aluminum alloy sheet is used for all the body panels.

All-aluminum alloy monocoque FORD **F-150**

The F-150 has become a major focus of interest for its switch to an all-aluminum body structure. The use of aluminum alloy materials has reduced the entire vehicle weight by about 320 kilograms.



All-aluminum alloy monocoque Range Rover **Sport**

Based on knowhow accumulated through the development of the Jaguar XJ, this is the first SUV to feature an all-aluminum body design.

Q7, the luxury Audi SUV, features an all-aluminum alloy body structure known as the ASF (Audi Space Frame) which has realized high rigidity and a low center of gravity. High-strength aluminum alloy extruded shapes are used for the front side members and front bumper.

Use of aluminum alloys in automobiles ❷

DRIVETRAIN & POWERTRAIN

The frame to support the drivetrain and powertrain requires both high rigidity and light weight. For this reason, frame structures using high-strength structural aluminum alloy sheet and extruded shapes are increasingly being used. More aluminum forged products are also being used for the suspension, as well as parts such as brake calipers, hub carriers, and steering knuckles.

Suspension arms

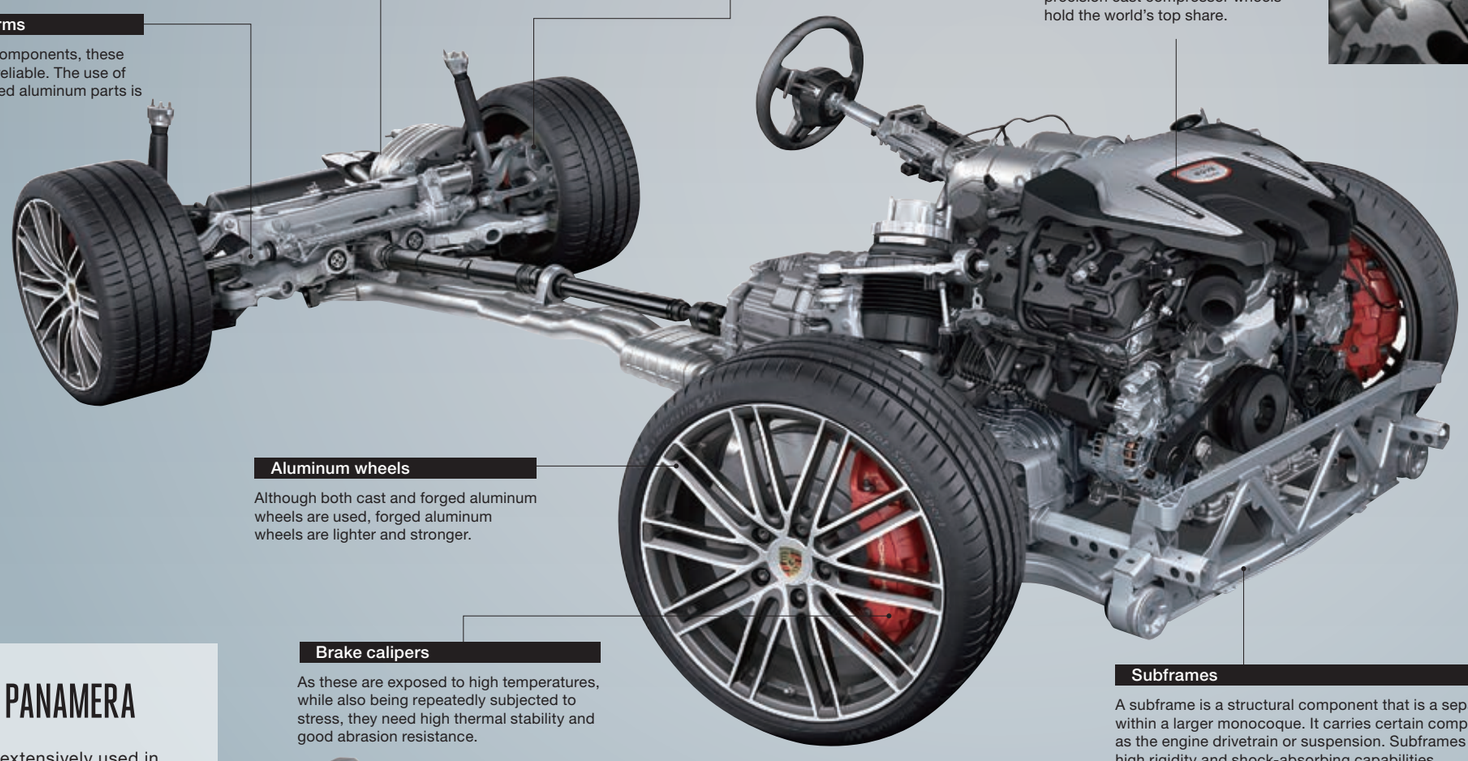
As critical safety components, these need to be highly reliable. The use of high-strength forged aluminum parts is increasing.

Heat insulator

This is a heat shield that protects the fuel system, brakes, and sensors from the high heat of the engine exhaust system.

Hub carriers

These components connect the suspension arms with the brakes and wheels.

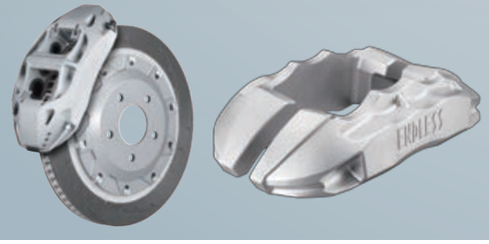


Aluminum wheels

Although both cast and forged aluminum wheels are used, forged aluminum wheels are lighter and stronger.

Brake calipers

As these are exposed to high temperatures, while also being repeatedly subjected to stress, they need high thermal stability and good abrasion resistance.

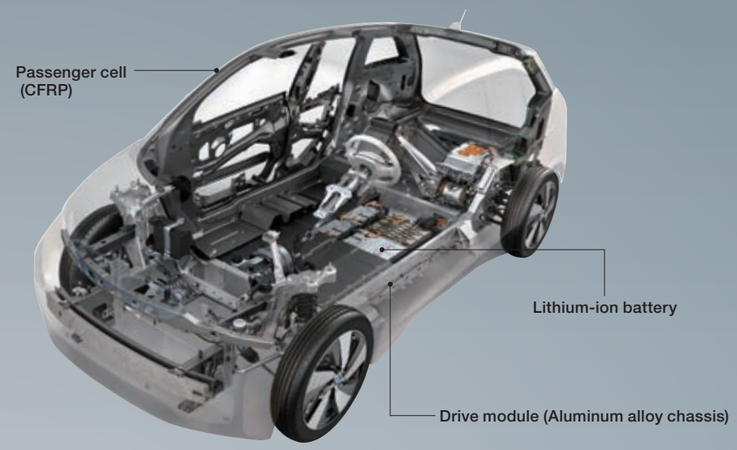


Subframes

A subframe is a structural component that is a separate structure within a larger monocoque. It carries certain components, such as the engine drivetrain or suspension. Subframes need to have high rigidity and shock-absorbing capabilities.

PORSCHE **PANAMERA**

Aluminum alloy is extensively used in the hybrid body and platform of this sports car. It adopts the standardized MSB (Modularer Standardantriebs-Baukasten) modular platform which is shared by the PANAMERA and Bentley Continental GT models.

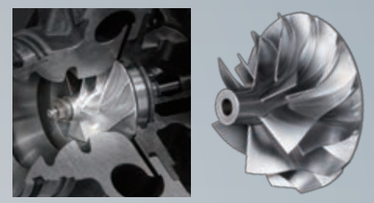


BMW **i3**

The body of this electric vehicle has a two-unit configuration. The upper unit (the passenger cell) is made of CFRP (Carbon-fiber-reinforced polymer), whereas the upper unit (the drive module) and the space frame are made of aluminum extruded shapes. The door panels also have extruded aluminum built-in frames.

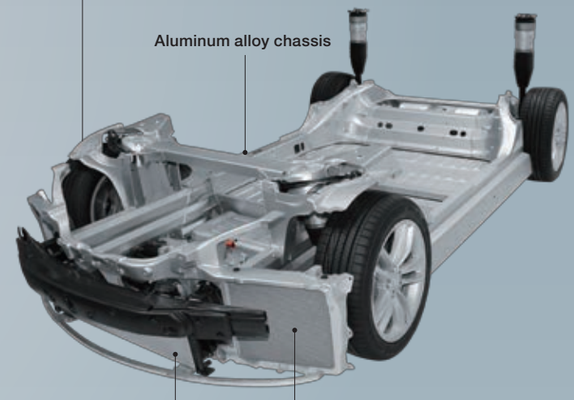
Compressor wheels for turbochargers

These are precisely manufactured aluminum alloy impellers used to compress air. UACJ's aluminum precision cast compressor wheels hold the world's top share.



TESLA **MODEL-S**

The chassis of the TESLA MODEL-S has an aluminum frame structure made of aluminum extruded shapes, with the battery cells arranged under the floor to achieve a low center of gravity. The body panels also adopt aluminum alloy sheet.



Forged aluminum alloys

Because of their high strength, high cyclic stress, and high reliability, forged aluminum alloys are used for structural parts such as suspension arms. Forging techniques include hot forging and cold forging, and alloys can be selected to match the properties of each part.

01

Aluminum alloys used in automobiles : 1

Aluminum alloy sheet

Aluminum alloy sheet features superior formability and strength

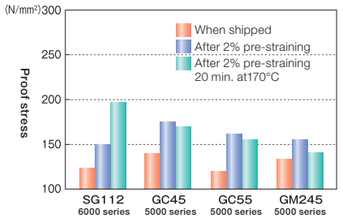
6000 series aluminum alloy sheet for body panels

Producing body panels from aluminum alloy sheet is a highly effective way to reduce weight and enhance fuel efficiency.
Currently, 6000 series aluminum alloy sheets are the type most commonly used in body panels, and since they have “bake-hardenability,” they can be strengthened during the coat baking process.
The 6000 series aluminum alloy sheets are characterized by low strength during the molding process, making them highly workable, but the coat baking process makes them substantially stronger.

Required properties of automobile body sheet
- Bake-hardenability
- Formability
- Hemmability
- Dent resistance
- Corrosion resistance
- High-luster paint finish

Change in proof stress from during forming to after coating

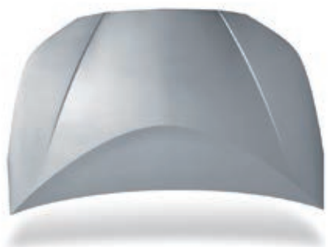
6000 series sheets are strengthened more than 5000 series sheets.

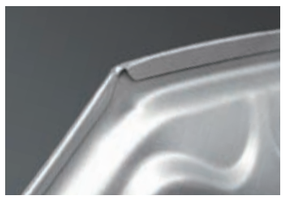


Change in proof stress of body sheets

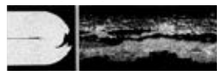
Bonnet of Toyota Prius

Both the interior and exterior structures are made from 6000 series aluminum alloy sheet.

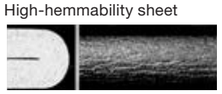




Ordinary body sheet



High-hemmability sheet

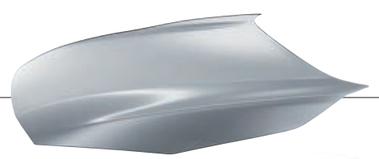


Hemming

Since aluminum alloy sheet is less elongate than steel sheet, it cracks easily during hemming. This means that flat hemming involving bending by 180 degrees has previously been difficult to achieve. However, UACJ Corporation has created an aluminum alloy sheet that can be subjected to Sharp Hemming, a process that is even more problematic than flat hemming.

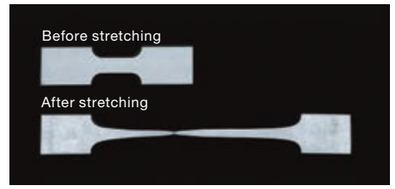
5000 series aluminum alloy sheets for body panels

5000 series aluminum alloy sheets are the strongest of the non-heat-treatable alloys and also have excellent press formability. Through finding the right amount of magnesium to add, and through nanostructure design control, UACJ Corporation has created aluminum alloy sheet that has formability similar to that of steel sheet.

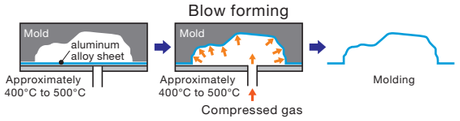


Superplastic aluminum alloy sheet

Superplastic material has elongation of more than several hundred percent at high temperatures.
Using the blow-forming method (using compressed gas to force heated material into a metal mold), superplastic aluminum alloy sheet permits greater design flexibility.
The UACJ superplastic aluminum alloy sheet marketed as ALNOVI, is now being adopted extensively.

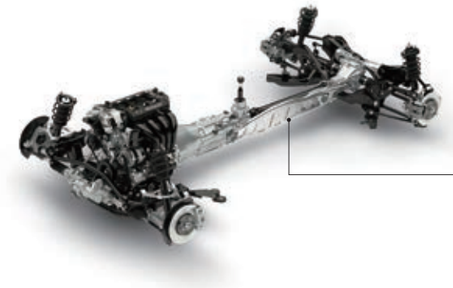


The trunk-lid panel of the TESLA Model-S with a complex curved surface is formed as a single unit with high-temperature blow forming. The merit here is that higher design flexibility can be achieved, even in small-lot cases.



Aluminum alloy sheet for high-strength structural components

Aluminum alloy sheet designed for high-strength structural components is suitable for use in automobile framework structures. The 7075 alloy (ultra-super duralumin) features the highest level of tensile strength, proof stress, and fatigue strength. It is used for chassis and subframes.



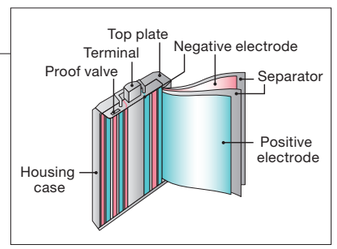
Power Plant Frame

This is an original Mazda-developed frame that increases the rigidity of the drivetrain and solidly connects the transmission to the differential housings. The frame is made from UACJ’s high-strength aluminum alloy sheet.

LIB products for EVs and HEVs

Aluminum alloy materials are also used in LIB products.
They are indispensable in the production of the foil used in the positive electrode, cans, busbars, and other peripheral components.

Aluminum materials used in LIB
- Aluminum cathode foils
- Housing cases
- Busbars
- Disclosure sealers
- Laminated pouches



Aluminum alloy busbars

Lithium-ion battery cell & Module

02

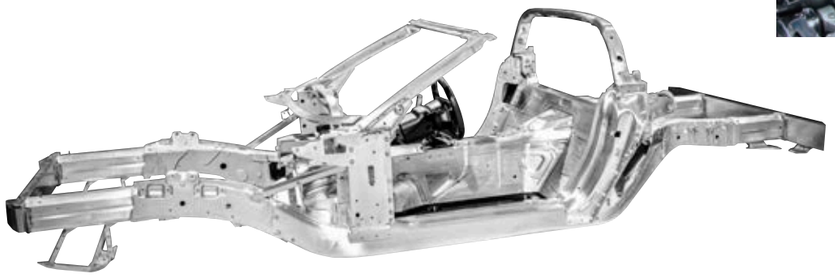
Aluminum alloys used in automobiles : 2

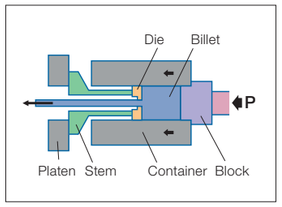
Aluminum extruded products

Components with complex cross-sectional shapes

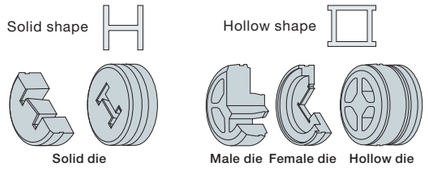
Aluminum extruded shapes

Using extrusion, it is possible to produce complex shapes. The process involves heating the aluminum alloy up to 400-500°C and pressing it through a die. Various shapes can be extruded, including complex shapes and hollow materials. They are normally used for automobile subframes and bumper beams.



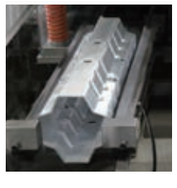


A space frame structure made of extruded aluminum shapes was adopted for the Chevrolet Corvette. A strong body structure with as much as 57% higher rigidity was realized, while also achieving a weight reduction of 45 kilograms compared to previous models.



Bumpers of the Mazda MX-5

This bumper is manufactured using a 7000 series aluminum alloy produced by UACJ Corporation for use in hollow shape extrusions.



Aluminum extruded products are used to produce motorbike frames and front forks. UACJ's front fork outer tubes hold the world's top share.

03

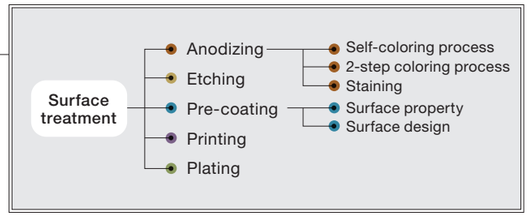
Aluminum alloys used in automobiles : 3

Aluminum alloy surface treatment

The beautiful transmuting appearance of aluminum with processed surfaces

Aluminum Design Sheets

The aesthetically pleasing appearance of aluminum is one of its major features. The sheen of luminous aluminum alloys can be further enhanced through electrolytic and chemical polishing, and they are used for decorative parts, such as vehicle moldings. Various surface treatment technologies can be used to accentuate the aesthetic qualities of aluminum.
UACJ manufactures luminous aluminum alloy design sheet with a focus on a level of sheen which can hardly be found anywhere else in the world. With this material, superior designs can be achieved through chemical and electrolytic polishing, and can also ensure anodizing properties.



Interior use of aluminum design sheets

Aluminum panels with surfaces beautifully processed and treated with hairlines and other designs, are widely used for cockpit interior decoration, such as in center console panels and door trims.

Parts made of aluminum alloy are ideal for creating a sporty impression. The beautiful sheen of aluminum sheets surely provides an incentive to choose them instead of resin.

Anodizing

Anodizing is a process that involves turning a piece of aluminum into an anode in an electrolytic solution to create a surface layer of oxidized aluminum. Colored oxide layers can be produced in black, red, blue, etc.

Evaluation and analysis technologies

UACJ works on simulations, analysis and evaluations in order to develop better aluminum alloys. Particularly useful for development is impact simulation analysis, fluid analysis and thermal analysis. CAE is used for considering the characteristics of materials and shapes to improve collision safety.

Crash boxes

04

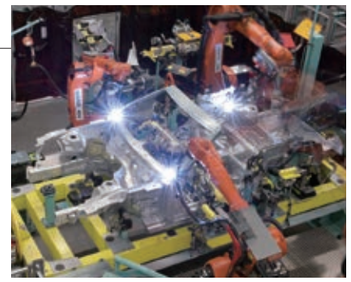
Aluminum alloys used in automobiles : 4

Aluminum alloy joining technologies

Enhanced aluminum presence in the current multi-material trend

Today, as in the past, fusion welding is the mainstream method for joining aluminum alloys. The two most common kinds of welding are Metal Inert Gas (MIG) and Tungsten Inert Gas (TIG). Aluminum alloys started being used to reduce vehicle weight, and this led to breakthroughs in the aluminum joining technologies now used in the manufacture of cars, including laser welding and Friction Stir Welding (FSW) for joining without a melting process, which are both now widely used. In the case of Mechanical Joining, the technology for fixing parts together with rivets, bolts and screws, self-piercing rivets and other devices have evolved. There is also the technology called Mechanical Clinching, which enables tight fixing without rivets.
Behind the rise in the number of body structures, there has also been an increase in the use of structural adhesives, and joining technology for combining different materials, such as aluminum and steel or aluminum and resin, continues to evolve.
Joining technology can be described as a trendy technology that is capable of contributing not only to the increased utilization of aluminum alloys, but also to reducing the weight of the vehicle body and the chassis structure.

Joining technologies



Punch riveting

Two sheets are joined by forcing a edge-shaped rivet through them.

Laser welding

A laser light is pointed at the parts to be joined to weld them together.

Flow drill screwing

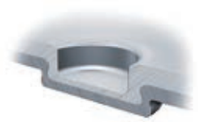
A method of screw fastening in which the fastening member can be removed.

Self-piercing riveting

The leg portion distorts and cuts into the base materials to fasten them together.

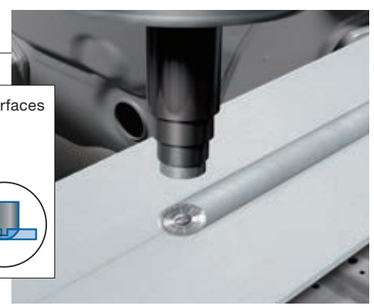
Mechanical clinching

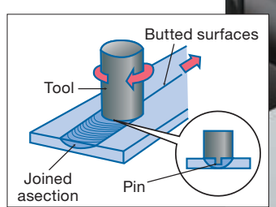
A die is used to clinch materials together from above and below.



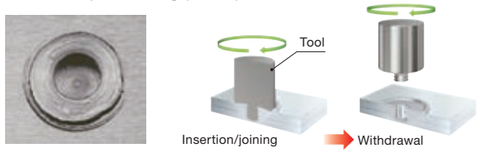
FSW-FSSW

Friction stir welding (FSW) is a joining technology that involves the use of a tool with a pointed revolving tip that is pressed against the metal, which is then softened by friction-generated heat. This plasticized material is used to join pieces of metal together.
This method has many benefits, including low levels of distortion and residual stress, and less significant reduction in strength when exposed to heat.

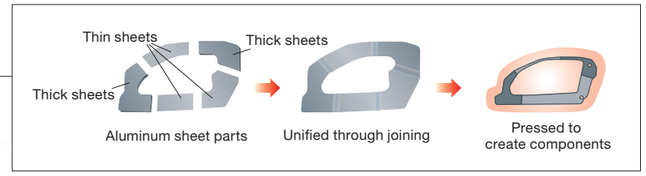




Friction stir spot welding (FSSW)



Tailored blanking



The first-generation Audi R8 was the first mass-market automobile to employ tailored blanking.

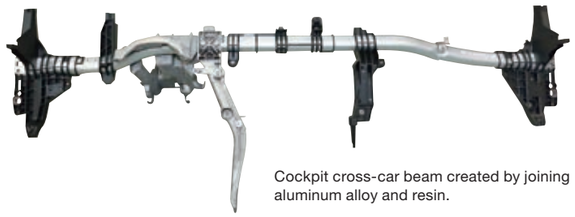
Tailored blanking is a production method that involves joining materials of differing thicknesses or qualities before press forming them. Since it is possible to position materials of differing strengths, thicknesses, and qualities only where they are required, the method contributes greatly to weight reduction.

Comparison of different joining methods

Method	Joining efficiency (speed m/min)		Quality			Cost	
	Thickness: 1 mm/1 mm	Thickness: 1 mm/2 mm	Tensile property	Formability: Stretch forming	Formability: Deep drawing	Device	Shielding gas
FSW	◎	◎	◎	◎	◎	○	◎
	2.0 ~ 4.0	2.5 ~ 3.5	Base material fracturing (5000 series)	Base material part fracturing	Base material part fracturing	Medium	Not needed
YAG laser	◎	◎	◎	◎	◎	△	△
	2.0 ~ 4.0	2.0 ~ 4.0	Base material fracturing (5000 series)	Base material part fracturing	Base material part fracturing	Expensive	Needed
Arc welding	△	△	◎	×	◎	◎	△
	~ 1.2	~ 1.2	Base material fracturing (5000 series)	Welded part fracturing	Base material part fracturing	Inexpensive	Needed

◎Excellent ○Good △Acceptable ×May require further consideration

Adhesion



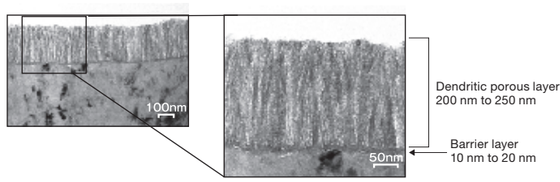
Cockpit cross-car beam created by joining aluminum alloy and resin.

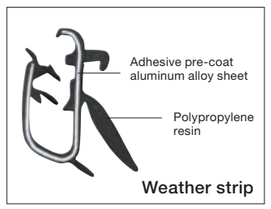
High-adhesive strength pre-coated aluminum alloy sheet

Aluminum alloy sheet material with a coating that is highly adhesive to resin is used to support the weather strip.

KO treatment sheet: high-adhesion aluminum sheet surface processing

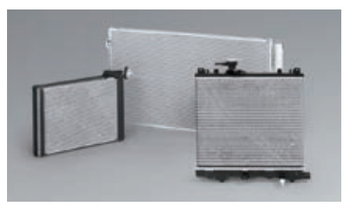
UACJ Corporation's KO processed aluminum sheet is covered with a high-adhesion oxide layer with a complex porous and dendritic configuration.

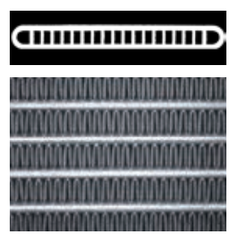




Brazing

Automobile heat exchangers are produced by assembling multi-hole flat tubes and corrugated brazing sheets. To reduce weight and enhance performance, heat exchanger materials are made thinner, so corrosion proofing is vital.





Intercooler

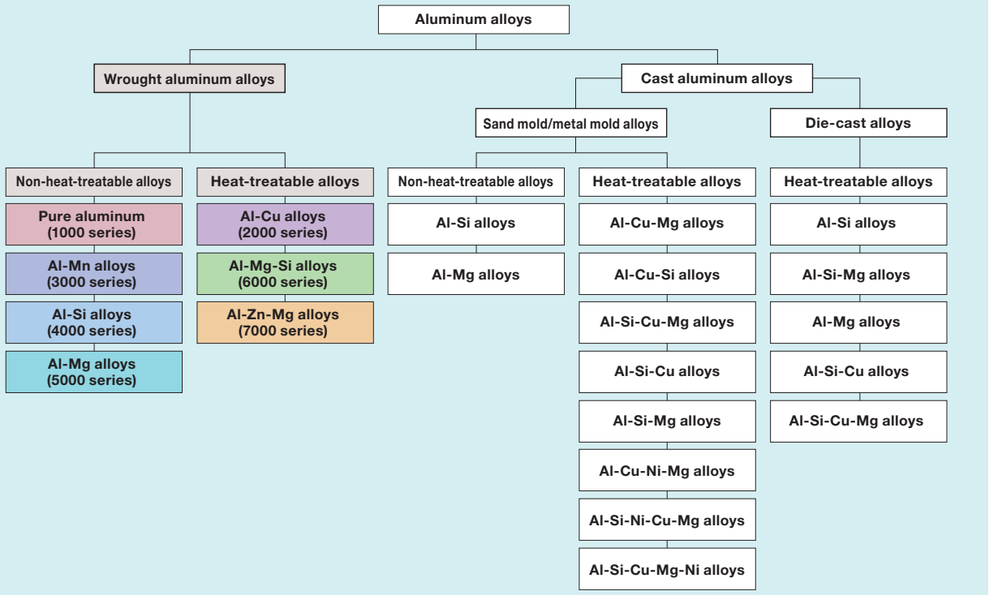
The core part of an intercooler is made of aluminum alloy, and the fins and tubes are braised to form a single unit.

Basic aluminum alloy information

Lightweight, strong, corrosion-resistant, highly formable, and featuring a beautiful surface, a great variety of aluminum alloys are used in automobile production.

Aluminum alloys can be roughly divided into wrought alloys and cast alloys. These two categories can be further divided into heat-treatable alloys and non-heat-treatable alloys.
There are two different types of cast aluminum alloys: sand mold/metal mold alloys and die-cast alloys.

Wrought aluminum alloys are processed by rolling, extrusion, etc., into a wide range of different shapes, including sheets, foil, shapes, tubes, and bars.
The properties of aluminum alloys change with the types and amounts of added elements.



The International Alloy Designation System

Rolled aluminum alloys are classified in accordance with the International Alloy Designation System (IADS) based on an agreement to which 22 countries and 24 organizations are a party. Four-digit code numbers are used to identify alloys, and the various alloys are precisely classified according to the types and amounts of added elements and impurities they contain, and their various threshold limit values.

There are currently more than 400 different aluminum and aluminum alloys registered and administered by the system.
The European standard ENAW-5052 alloy and the Japan Industrial Standard A5052 alloy share the same four-digit number (5052), and this means that the chemical constituents of the alloys are exactly the same. For this reason, it is reasonable to say that rolled aluminum alloy specifications are more internationalized than those of any other metallic material. Cast aluminum alloys, on the other hand, are still not subject to an international alloy registration system like the one for rolled aluminum alloys.

Reference from European Aluminium
www.european-aluminium.eu

The general properties of aluminum alloys

1000 series aluminum

This refers to pure aluminum materials: 1100 and 1200 are the most common types. 1050, 1070, and 1085 indicate that they have a purity of at least 99.50%, 99.70%, and 99.85% aluminum respectively.
1000 series aluminum is not a high-strength material, but it has excellent corrosion resistance and formability, and because it also has a highly lustrous surface it is often used for decorative parts, nameplates, reflective plates, etc.
The material also features excellent electrical conductivity and heat-conductivity, and 1060 and 1070 are often used for power lines and heat dissipation materials.

2000 series alloys

Representative alloys in this series are 2017 and 2024, which are known as duralumin and super duralumin respectively. They are almost as strong as steel.
On the other hand, they include copper, so they are relatively lacking in corrosion resistance, and when used in corrosive environments they therefore require anti-corrosion treatment.
2014 is commonly used as a high-strength forged material.
2000 series alloys are highly machinable. 2011, in particular, is commonly used for machine components due to its high machinability.

3000 series alloys

The representative alloy in this series is 3003, and the addition of Mn means it is an alloy that retains the formability and corrosion resistance of pure aluminum while boasting increased strength. It is commonly used for utensils, containers and as a building material.
The 3004 and 3104 alloys are based on the 3003 alloy but contain approximately 1% Mg to further increase their strength. They are used for aluminum cans, roof cladding, door panels, etc.

4000 series alloys

The addition of silicon to the 4032 alloy reduces thermal expansion and improves abrasion resistance. Forged material for pistons also has other trace additives such as Cu, Ni, and Mg, which enhances heat resistance.
As the melting temperature of 4043 is low it is used for welding wire and brazing filler metals. Thanks to the dispersal of Si particles, 4043 also has a beautiful gray coloring when anodized.

5000 series alloys

5000 series alloys with relatively low levels of Mg are used as decorative materials, etc., and those with relatively high Mg levels are used for structural materials.
Typical of the alloys with a moderate amount of Mg is 5052. It is the most versatile. The alloy 5083 contains a large amount of Mg and is the strongest of the non-heat-treatable alloys. Also being suitable for welding, it is used for welded structural materials in boats, automobiles, chemical plants, etc. It performs well in environments exposed to seawater or pollution.

6000 series alloys

6000 series alloys have medium to high strength and good corrosion resistance.
The 6061-T6 alloy has a proof stress of over 245N/mm^2, meaning it is a high-strength alloy comparable to ASTM A36 (JIS3101 SS400) structural carbon steel.
The 6063 alloy is excellent material for extrusion, and it is widely used as a construction material, particularly for window frames.

7000 series alloys

The 7000 series alloys can be divided into two groups: Al-Zn-Mg-Cu alloys, which are the strongest of all aluminum alloys; and Al-Zn-Mg alloys, which are used for welded structural materials.
7075, one of the leading Al-Zn-Mg-Cu type alloys, is used in aircraft and trains.
7204, one of the leading Al-Zn-Mg type alloys, is strong, and room-temperature age hardening means that welded parts recover to a strength similar to that of the base material, giving it superior joining efficiency.

Other alloys

Since the addition of Li to aluminum makes it less dense and increases its Young's modulus, it is garnering attention as an ideal low-density, high-strength material suitable for use in aircraft and large structural materials.
New 8000 series alloys are being developed, such as internationally registered powder metallurgy aluminum alloys, etc.

Aluminum usage guidelines

The table on this page explains the characteristics of the different alloys types and what automobile components they are used in.

	Alloy designation		Characteristics	Use in automobiles
	AA	UACJ		
1000 Al	1050	A50	Excellent processability and surface treatability. The most corrosion-resistant of all aluminum alloys.	Heat insulators
	1100	A30	General-purpose aluminum with over 99.0% purity. Surface appears slightly white after anodizing.	Heat insulators, license plates
	1200	A0		Heat insulators
2000 Al-Cu	2014	14S	Very strong alloy used for structural components. Because of relatively higher copper content, inferior corrosion resistance.	Motorbike handles, ABS
	2017	17S		Shock absorbers, handles, spokes, conrods
	2024	24S		
	2219	B19S	High-strength, excellent properties at high and low temperatures, superior weldability, but inferior corrosion resistance.	Rotors, brake components
		CG29	Higher strength at elevated temperatures than that of 2618.	Conrods, pistons
		CB156 CB256 KS26	Lead-free highly-machinable alloys.	AT valves
	2618	2618	High-strength at high temperatures. Saitable for forging and machining.	Compressor wheels, Pistons
		20A1		
3000 Al-Mn	3003	303S D3S	10% stronger than 1100. Good processability and corrosion resistance.	Piping
	3004	304S 4S	Stronger than 3003. Excellent deep-drawability, and good corrosion resistance.	Cowl grilles, heat insulators
4000 Al-Si	4032	32S	Excellent heat and abrasion resistance. Low thermal expansion coefficient.	Pistons
		SC100	Excellent abrasion resistance and forgability. Stronger than 4032.	Power steering housing, compressor scrolls, valve lifters
		SC300	A stronger version of SC100.	
		TF06B TF08 TF10B	Excellent abrasion resistance and forgability. Stronger than 4032.	
		TF12B	A hypereutectic alloy with enhanced forgability.	Compressor rotors
5000 Al-Mg	5052	52S	A medium-strength alloy. Good corrosion resistance and formability. High fatigue strength.	Meter display panels, AT drums, air bag inflators, covers
	5454	D54S	20% stronger than 5052. Good corrosion resistance.	Wheel rims, suspension components
	5083	183S	An alloy for use in welded structures. The strongest of the non-thermally treated alloys.	Tanks, gas cylinders
		383S	A high formability version of 183S. Excellent superplastic properties.	
		483S NP5/6	An extrusion alloy version of 183S.	Lashing rails
	5182	A82S	Nearly as strong as 5083. Good processability and corrosion resistance.	Dust covers, seat frames, air cleaner cases, spring sheets
		GM145	Good formability and stress corrosion cracking performance.	Body panels (interior)
	5154	A154S	20% stronger than 5052. Good formability.	Wheels, underbody components, drivetrain components, suspension components
		A254S	20% stronger than 5052. Good stress corrosion cracking performance.	
		GC32	Good formability and stress corrosion cracking performance.	

Alloy designation: “AA” means the designations used by the Aluminum Association.

	Alloy designation		Characteristics	Use in automobiles
	AA	UACJ		
5000 Al-Mg	5022	GC45 TG19	High-strength, high-formability body panel material. Low coat-baking proof stress reduction.	Bonnets, roofs, doors, pillars, oil pans, floors, rear fenders, air cleaner housings
		GC150	A slightly stronger alloy than GC45.	Body panels
	5023	GC55 TG25	Body panel material with further enhanced formability.	Bonnets, roofs, trunk lids, instrument panels, seat buckets, knee protectors
	5110A	257S	A high brightness alloy with the same strength as 3003. Good deep-drawability and corrosion resistance.	Moldings, trims, reflective panels, headlamp bulb shades
	5056	356S	A non-heat-treatable alloy for welded structures. Excellent seawater resistance.	Brake pistons, fuel delivery pipes, airbag inflators
6000 Al-Mg-Si		SG112 SG212 TM30 TM55	Body panel alloy with high bake hardenability, formability, and high-hemmability.	Bonnets, rear fenders, front fenders, pillars, wheel housings, roofs, doors
		SG312 TM66 TM67	BH type body panel alloy. Even stronger than SG112 with good formability.	
	6061	61S 161S	Heat-treatable alloys with good corrosion resistance.	ABS, crossmembers, wheels, propeller shafts, arms, links, air bags, joists, receiver tanks
		561S		Power plant frames
	6013	SG210	High-strength aluminum alloy for forging.	Suspension arms
	6063	63S 163S Y63	Typical extrusion alloys. Lower strength than 6061, but superior extrusion properties.	Moldings, seat frames, truck bed gates, roof railings, piping
	6005C	465S L55	Intermediate strength between 6061 and 6063. Good corrosion resistance and weldability.	Bumpers, space frames, engine brackets, seat frames, ABS, side sills, shock absorbers
		SG109	High-strength alloy with good bendability and corrosion resistance. Hollow extrusion is possible.	Bumper reinforcement, space frames
		SG10 SG310	The strongest of the 6000 series alloys.	Wheels, propeller shafts, arms, links
		GT209 KS69S	Lead-free high-machinability alloy.	AT valves
7000 Al-Zn-Mg	7075	75S	Typical high-strength alloy for use in aircraft manufacture.	Seatbelt hinges, links, bobbins, retractors
	7178	A78S	The strongest aluminum alloy.	Keys
	7003	ZK60 K73	An extrusion alloy for welded structures. Better extrusion properties than 7204.	Bumper reinforcement, seat sliders, motorbike frames, door impact beams, motorbike rims
	7204	ZK141 K70	Alloys for welded structures. The strength at the welded part recovers almost to the same as that of the raw material by natural aging.	Steering components, crossmembers, brake pedals
	7204	ZK147 K70Y		Jacks
		ZK55	Even stronger than 7204. Welding and hollow extrusion is possible.	Bumper reinforcement, impact beams, motorbike frames and rims
	7046	ZK170		
	7050	ZG62	High-strength aluminum alloys.	Motorbike front forks
		ZC88		

Aluminium Material for Automobiles

The environment-friendly metal underpinning
next-generation automobile development

A Very Popular Japanese Magazine

BACK NUMBERS

Motor Fan
illustrated

Motor Fan illustrated
Publisher: SAN'EI SHOBO PUBLISHING CO., LTD
7F Shinjuku East Side Square, 6-27-30 Shinjuku,
Shinjuku-ku, Tokyo 160-8461, JAPAN
http://www.motorfan-i.com/
email: mfi@san-eishobo.co.jp

'Motor Fan illustrated' is a very popular Japanese magazine dedicated to automotive technologies, materials, car electronics, and production processes.
It is a unique publication because it presents technical information using expressive terminology, and it is also graphically beautiful, with many photographs and illustrations to enhance the understanding of the articles. As a result, many enthusiastic non-Japanese readers from all over the world enjoy reading it.
Motor Fan illustrated has been published for ten years and it is read by automotive engineers, university students, and auto enthusiasts. The magazine is supported by engineers of JOEM and suppliers.
The editorial concept of the magazine is: 'The more technologies are revealed, the more interesting cars become.'

UACJ Corporation

Tokyo Sankei Bldg., Otemachi 1-7-2, Chiyoda-ku, Tokyo, 100-0004 Japan
TEL : +81-3-6202-2667, FAX : +81-3-6202-2032

Website: www.uacj-automobile.com
E-mail: automobile@uacj-groupweb.jp

Motor Fan illustrated ATZ Extra Issue
SAN'EI SHOBO PUBLISHING CO., LTD
Publisher: Satoshi SUZUKI Editor in Chief: Shin-ichi SUZUKI Editor in Chief: Haruya KATADA
Shinjuku East Side Square, 6-27-30 Shinjuku, Shinjuku-ku, Tokyo 160-8461, JAPAN