English Version

ATZ Extra Issue

Motor Fan illustrated

Special Edition

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

Special Feature **Aluminum Technology 5**

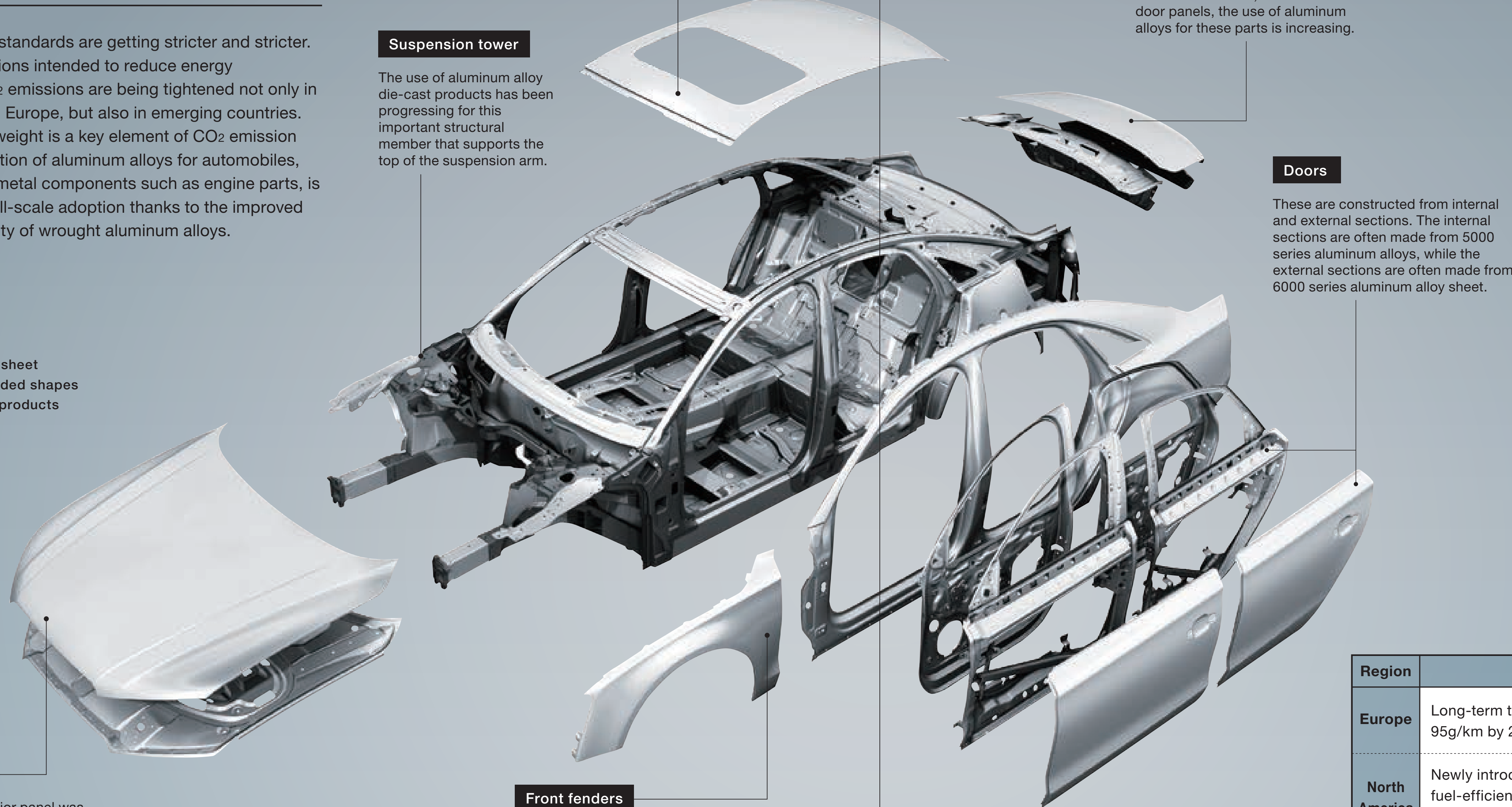
ALUMINUM

Smart Developments

BODY Panels

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.

- Aluminum alloy sheet
- Aluminum extruded shapes
- Aluminum cast products



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.

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.

Back door & trunk lid

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

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 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.

››› 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, 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

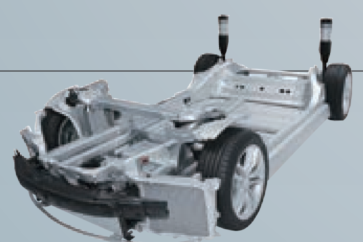
Typical examples of automobile parts that are now made from aluminum cast products are cylinder blocks, transmission cases and wheels. They are also ideal for members connecting the body and chassis, such as in the area connecting the suspension tower with the cross members and front side members.

Region	Fuel Economy Regulation
Europe	Long-term target for required fuel efficiency: CO_2 emissions of 95g/km by 2021
North America	Newly introduced fuel-efficiency standards to be reached by 2025: fuel-efficiency of 54.5 mpg (23.2km/ℓ) for passenger cars and small trucks; CO_2 emissions up to 143g/mi (89g/km) for passenger cars
Japan	Target fuel efficiency: 20.3km/ℓ (JC08 Mode) for gasoline-powered passenger cars by 2020

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 chassis

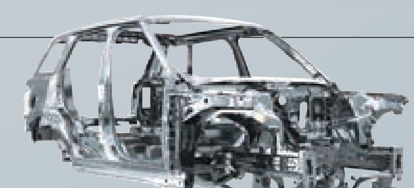
› TESLA **MODEL-S**

The chassis of the Tesla Model-S has an all-aluminum frame structure. The battery cells are arranged beneath the flat floor. Aluminum is also used for all the body panels.

All-aluminum alloy monocoque

› JAGUAR **XE**

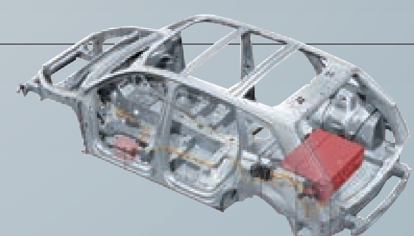
The XE is the first model built on the Jaguar Land Rover modular platform. The body structure of the 2017 XE's is 75 percent aluminum, the highest of any in its class.



All-aluminum alloy monocoque

› Range Rover **Sport**

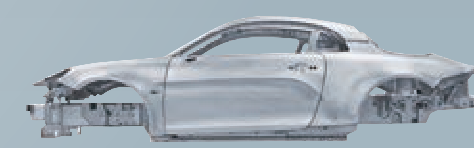
Based on knowhow accumulated through the development of the Jaguar XJ, this is the first SUV to feature an all-aluminum body design.



All-aluminum alloy space frame

› Audi **Q7**

Q7, features an all-aluminum alloy body structure. High-strength aluminum alloy extruded shapes are used for the front side members and front bumper.



All-aluminum alloy monocoque

› RENAULT **ALPINE A110**

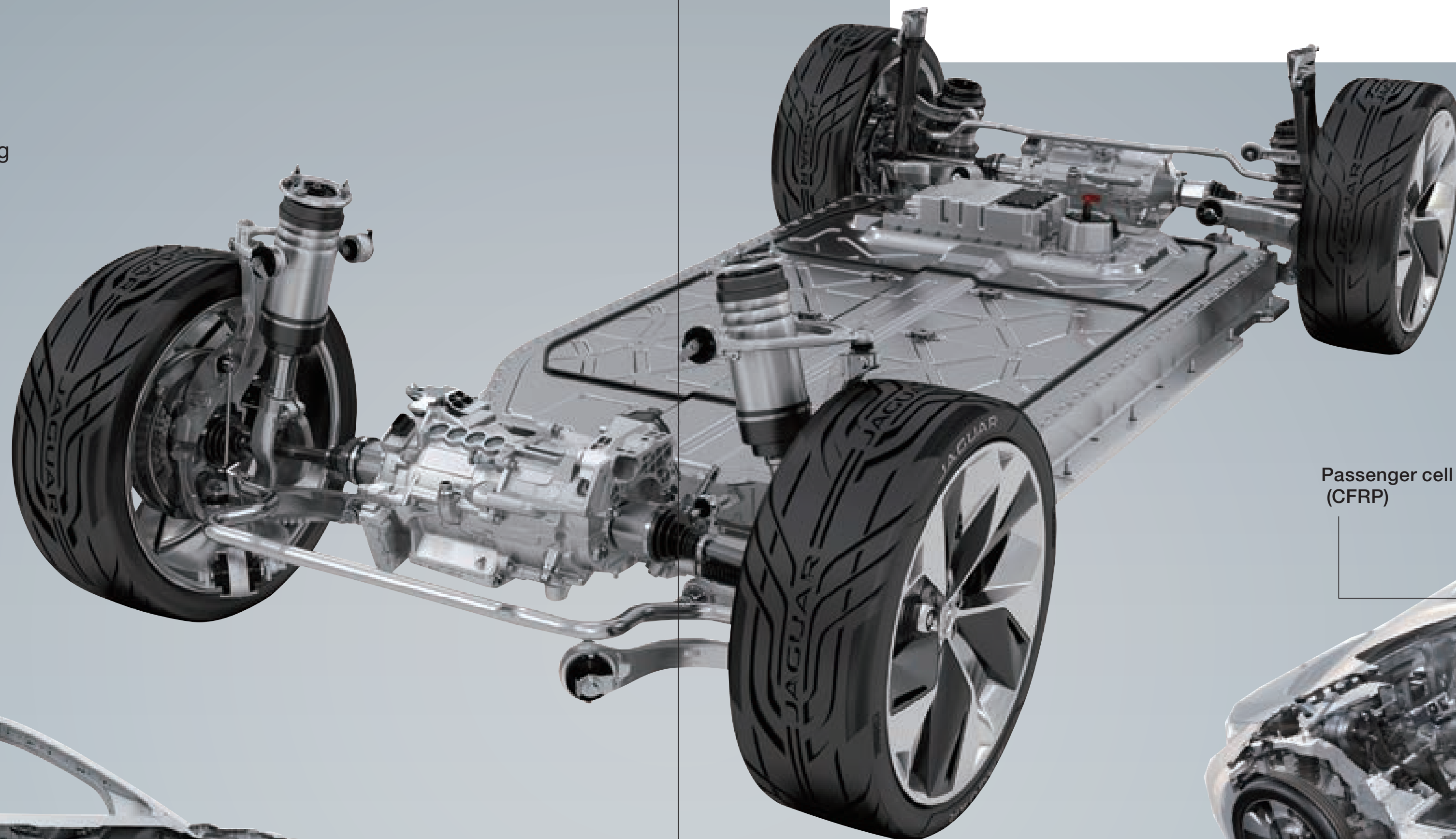
The weight of the new Alpine A110 is as low as 1,103 kilograms thanks to the all-aluminum alloy platform and upper body structure.

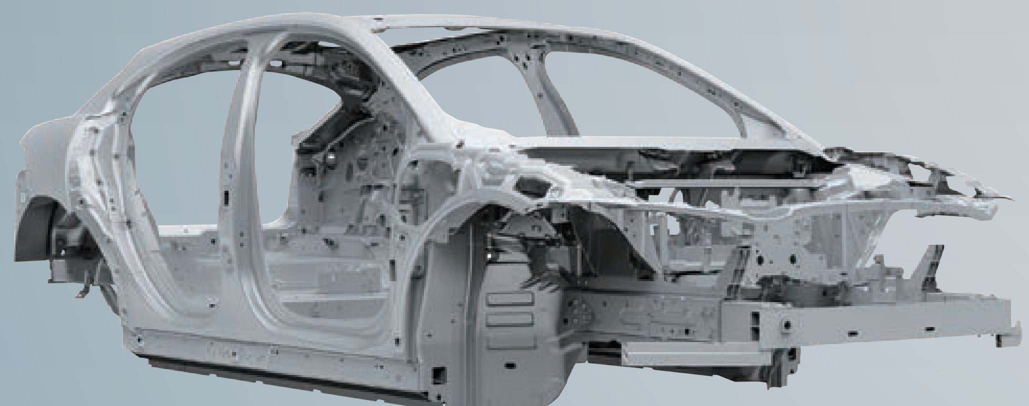
CHASSIS & POWERTRAIN & DRIVETRAIN

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.

JAGUAR **I-Pace**

The I-PACE is the SUV version of Jaguar's first all-electric vehicle, with a body consisting of 93% aluminum. This light and strong architecture delivers exceptional torsional stiffness. The I-PACE uses two electric motors, one on each axle, for permanent four-wheel drive. Its power train provides 400PS of power with 696Nm instantaneous torque, powered by a 90kWh lithium-ion battery. It was chosen by 60 automotive journalists from 23 European countries as the winner of the 2019 European Car of the Year Award.



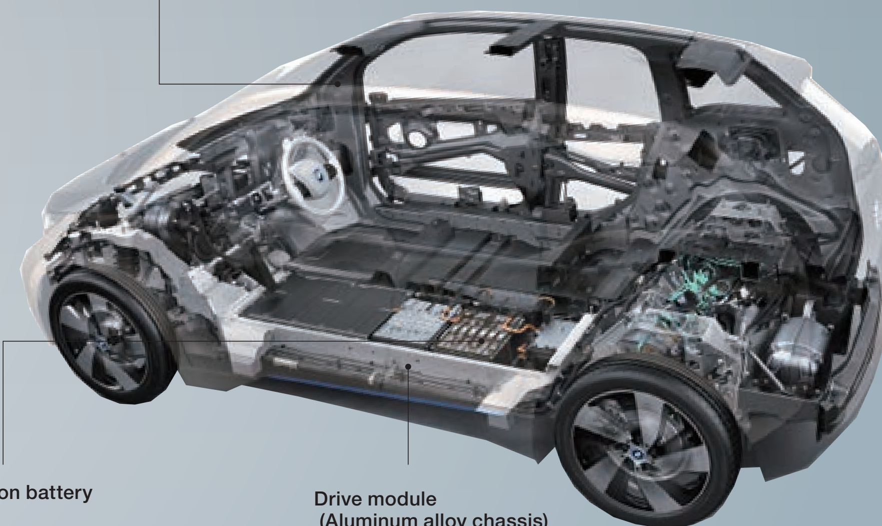


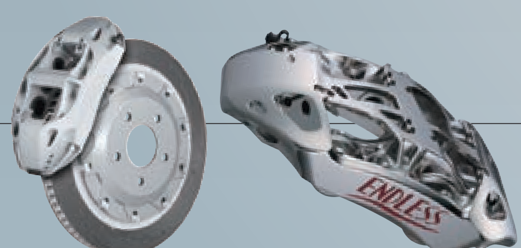
Small overlap test

Small overlap frontal crash tests are conducted by the Institute for Highway Safety (IIHS). In the test, 25% of a vehicle's front end on the driver's side strikes a rigid barrier at 40mph (64kph). The overlap percentage is much lower than in a conventional 40% off-set crash, which means the strength required for the cabin becomes greater.

BMW **i3**

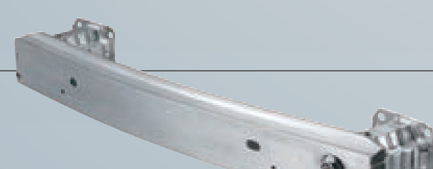
The body of this electric vehicle has a two-unit configuration. The upper unit (the passenger cell) is made of CFRP (Carbon-fiber-reinforced polymer), whereas the upper unit (the drive module) and the space frame are made of aluminum extruded shapes. The door panels also have extruded aluminum built-in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





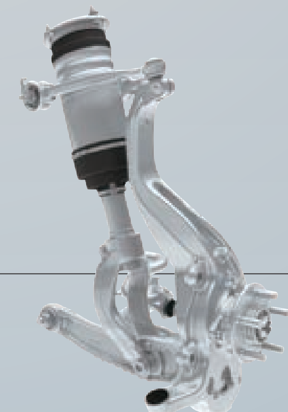
Brake calipers

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



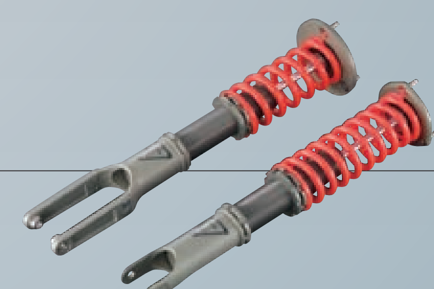
Bumper reinforcement

The bumper reinforcements made of the 7000 series high-strength aluminum alloy extruded shapes are excellent in terms of the absorption of impact energy. However, to produce such hollow shapes requires advanced extrusion techniques.



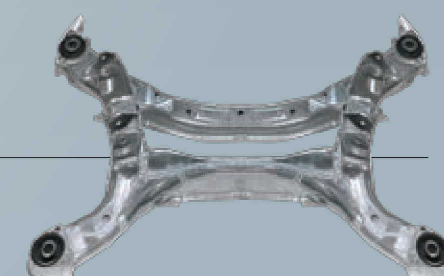
Suspension arms

As safety critical components, suspension parts need to be highly reliable.
In order to enhance riding comfort and driving stability, use of high-strength forged aluminum alloy is expanding for axle parts such as suspension arms and hub carriers, and other parts.



Shock absorbers

Aluminum shock absorbers are widely used on 2-wheeled vehicles. Each shock absorber installed between the car body and the tyre consists of a spring which determines the posture and cushioning buffer action and a damper which suppresses vibration.



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.

Aluminum alloys used in automobiles : 1

Aluminum alloy sheet

»» Aluminum alloy sheet features superior formability and strength

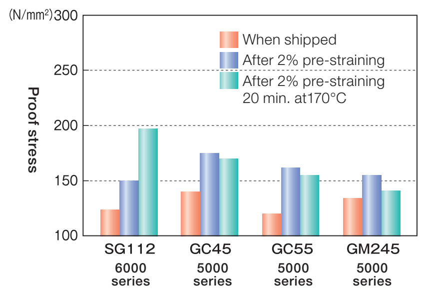
6000 series aluminum alloy sheet for body panels

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.

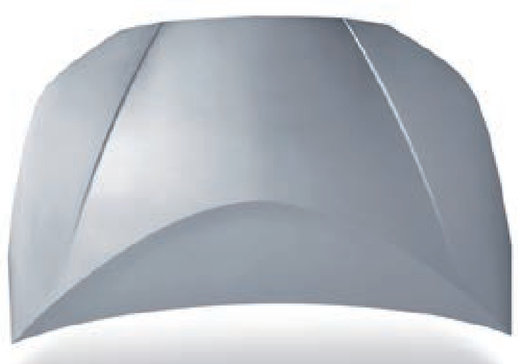


Change in proof stress of body sheets

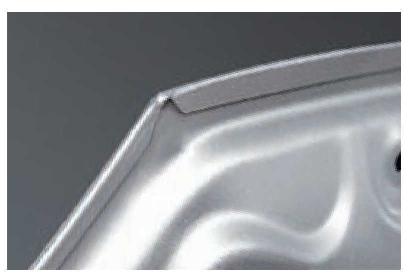
The LEXUS LS door panels (inner/outer)

←↑ This photograph shows how deeply the alloy was drawn to produce this inner door panel. 6000 series aluminum alloys are used for both the inner and outer door panels of the LS.

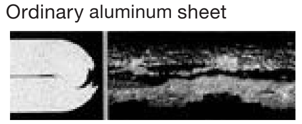
Bonnet of Toyota Prius



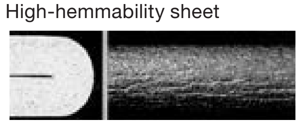
Both the interior and exterior structures are made from 6000 series aluminum alloy sheet.



Ordinary aluminum sheet



High-hemmability sheet

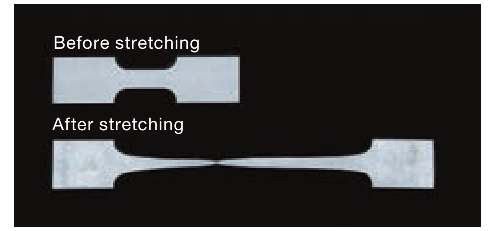


Hemming

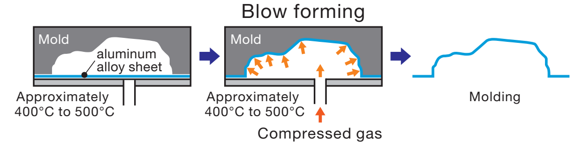
Since aluminum alloy sheet is less elongate than steel sheet, it cracks easily during hemming. This means that flat hemming involving bending by 180 degrees has previously been difficult to achieve. However, UACJ Corporation has created an aluminum alloy sheet that can be subjected to Sharp Hemming,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

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.

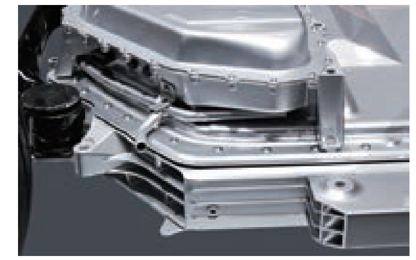


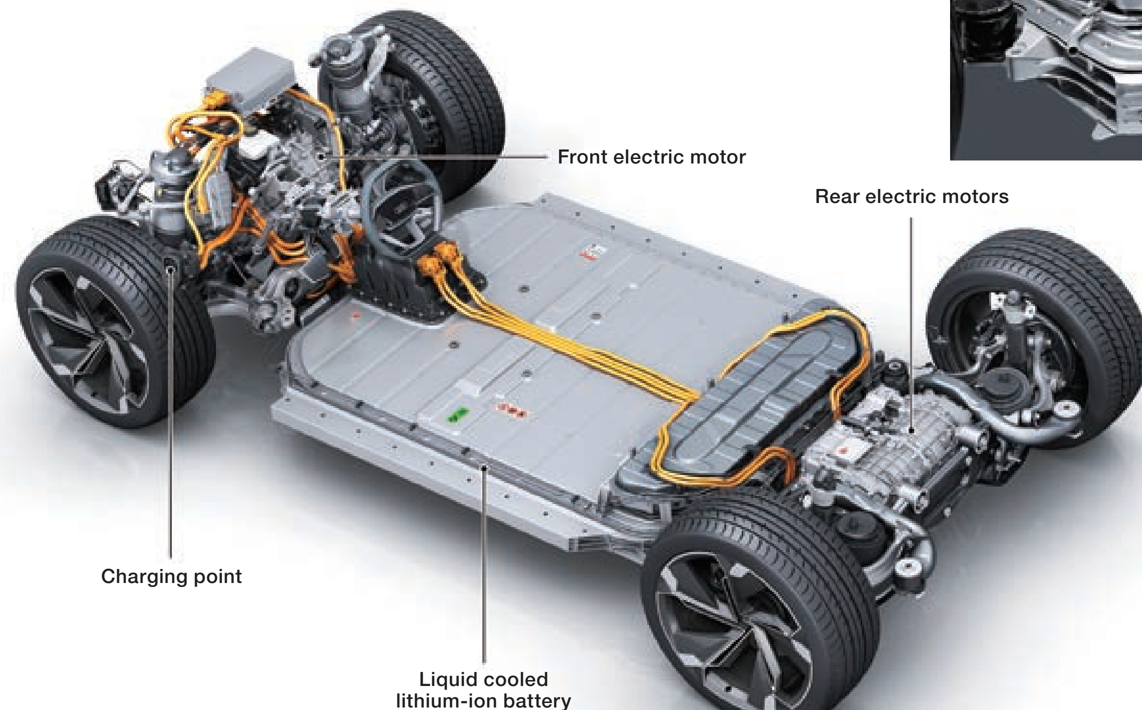
Blow forming



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.

EV platform





The large-capacity lithium-ion battery loaded on the Audi e-tron is made up of aluminum alloy modules, each containing 12 ‘pouch’ cells. To produce the battery pack, the modules are placed in an aluminum alloy housing.

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

Regarding the structure of vehicles which are rapidly making their way to being electric-powered, it is now becoming standard to lay out the lithium-ion batteries in an aluminum frame positioned under the floor as part of the body structure. Tesla took the initiative and the BMW i3 was the pioneering model for this. Audi’s e-tron has adopted a similar structure and Jaguar’s I-PACE displays the same concept. The mileage of an EV depends on battery capacity, but the greater the capacity of the loaded batteries, the heavier the total vehicle weight becomes. That is why the use of lightweight aluminum alloys is favored. For example, the Audi e-tron’s battery housing consists of 47% aluminum extruded shapes, 36% aluminum sheets, and 17% aluminum cast products. Despite being made of aluminum, the total weight of the system reaches up to 700kg. Considering the structure in terms of shock being dispersed during a side collision, thermal management, and other factors, an aluminum frame can now be regarded as the standard for an EV platform.

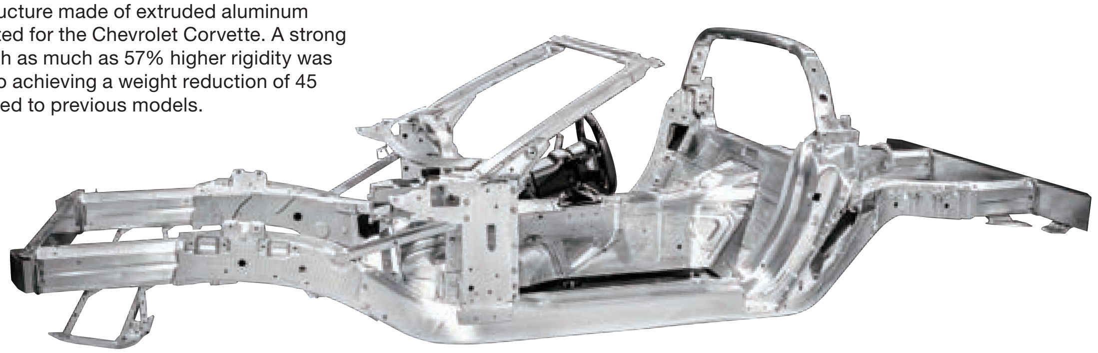
Aluminum alloys used in automobiles : 2

Aluminum extruded products

»» Components with complex cross-sectional shapes

Aluminum extruded shapes

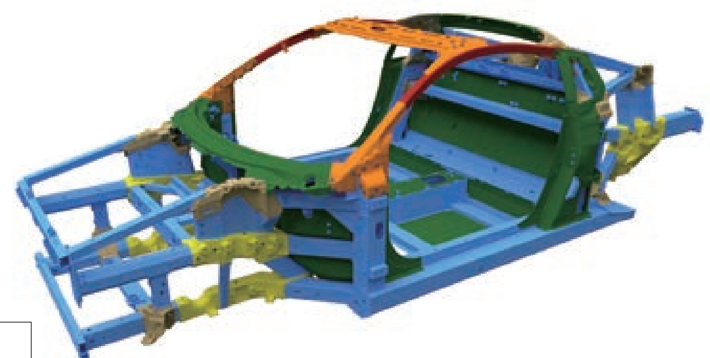
Using extrusion, it is possible to produce complex shapes. The process involves heating the aluminum alloy up to 400-500°C and pressing it through a die. Various shapes can be extruded, including complex shapes and hollow materials. They are normally used for automobile subframes and bumper beams.



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.

Space frame using multi-materials

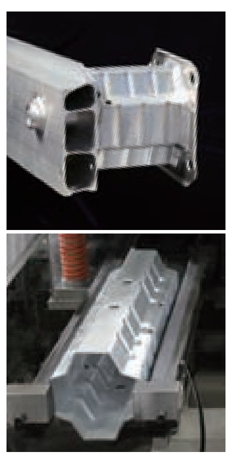
The NSX for the 21st century is not an all-aluminum body structure, but a multi-material space frame structure using aluminum, ultra-high tensile strength steel, resin and other materials. Mainly high-strength extruded aluminum shapes are used. Aluminum alloy accounts for about 79% of the whole structure; other materials include 13.5% of steel and 7.4% of resin.

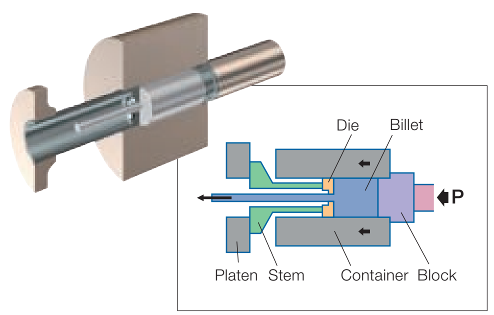


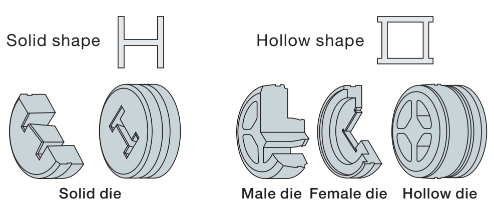
- Aluminum extruded shapes
- Aluminum alloy sheet
- Ultra-high tensile strength steel
- Ablation cast aluminum
- Gravity die cast aluminum
- Steel

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.







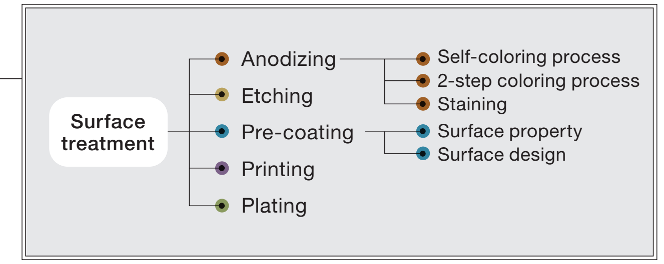
Aluminum alloys used in automobiles : 3

Aluminum alloy surface treatment

»» The beautiful transmuting appearance of aluminum

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.

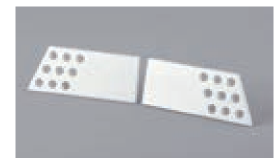


Interior use of aluminum design sheets

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.

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.

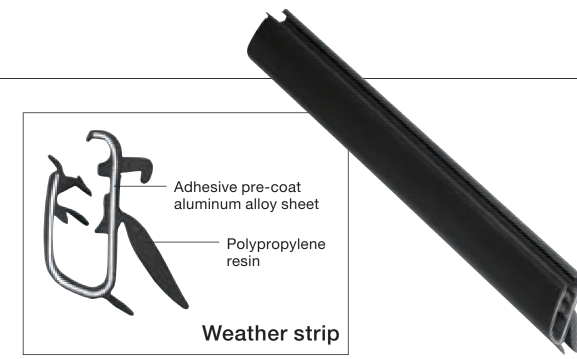


The beautiful sheen of aluminum sheets surely provides an incentive to choose them instead of resin.

Pre-coated aluminum alloy sheet

Surface treated aluminum sheet features great functionality.

Functions	Special features
Lubricity	Press forming with volatile press oil is possible, allowing omission of the degreasing process.
Adhesiveness	It is highly adhesive to PP resins, allowing non-use of adhesive materials.
Heat dissipation	Coated layer containing pigments with excellent heat dissipation diffuses heat.
Conductivity	It has excellent conductivity so that continuity is achieved on the coated layer.

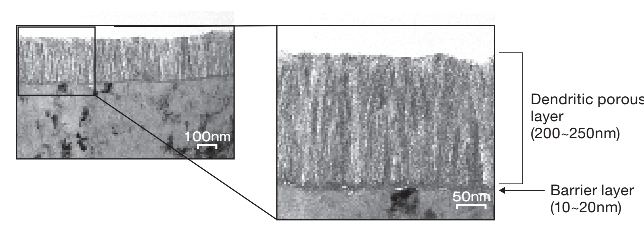


High-adhesive strength pre-coated aluminum alloy sheet

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

KO treatment highly adhesive aluminum sheet

A process to give an AC electrolysis treatment to aluminum sheet in an alkaline electrolytic solution in order to form a porous and dendritic oxide layer.
The anode oxide layer has a thickness of 2~10μm
Thickness after KO treatment: 200~250nm
(The KO treatment sheet is very thin, only 1/10 to 1/40 the thickness of an anode oxide layer.)



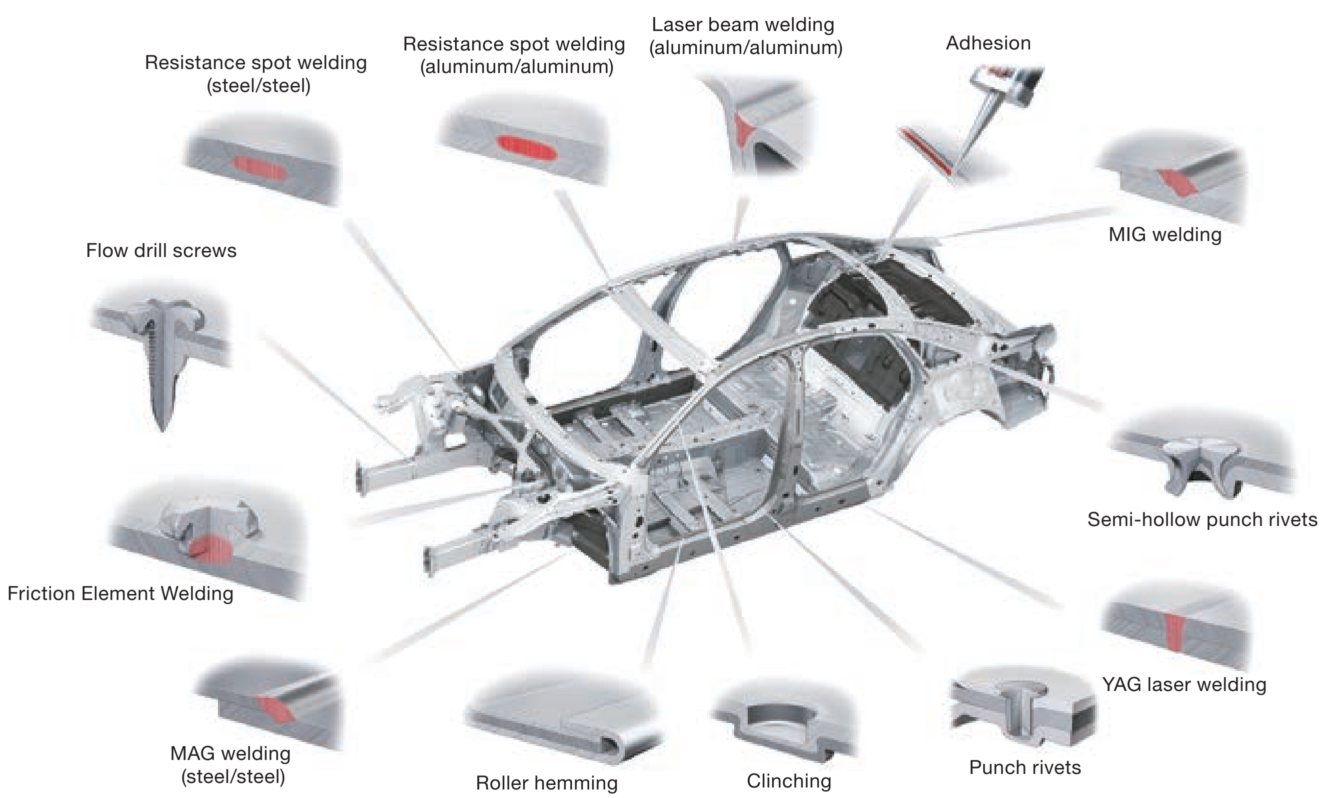
Aluminum alloys used in automobiles : 4

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 were introduced to reduce vehicle weight, and this led to breakthroughs in the aluminum joining technologies used in the manufacture of cars, including laser welding and Friction Stir Welding (FSW), for joining without a melting process. These technologies are both being used widely today. In the case of Mechanical Joining, the technology for fixing parts together with rivets, bolts and screws, self-piercing rivets and other devices has 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.
Moreover, joining technology for combining different materials, such as aluminum and steel or aluminum and resin, continues to evolve. It 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.

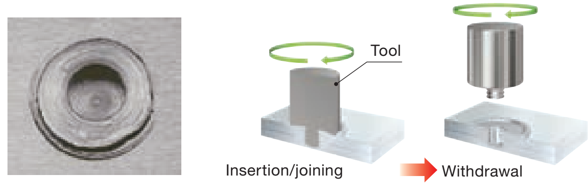
Evolving joining technologies for aluminum



FSW-FSSW

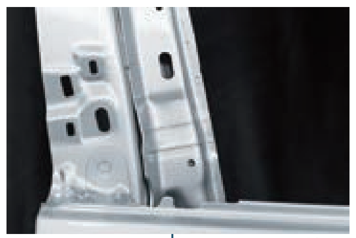
Friction stir welding (FSW) is a joining technology that involves the use of a tool with a pointed revolving tip that is pressed against the metal, which is then softened by friction-generated heat. This plasticized material is used to join pieces of metal together.

Friction stir spot welding (FSSW)



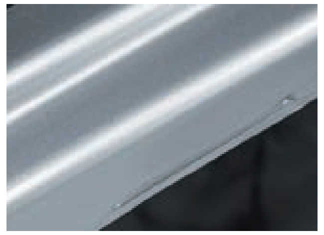
Tailored blanking

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.

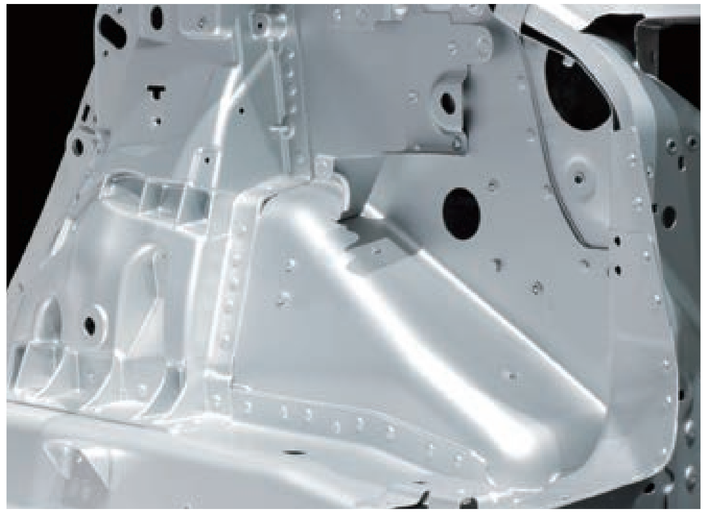


Evolving aluminum joining technologies

Toyota's LSW (laser screw welding) offers various advantages such as increased productivity and short pitch welding.



Fine welding beads are produced by laser seam welding. Laser welding suppresses thermal distortion to a minimum.



Adhesion

Increasing the joint rigidity of each body part is directly linked to the improvement of the vehicle's responsiveness and the quality of the ride comfort. Body rigidity is increased by surface bonding of the vehicle body joint portions, not only by spot welding but also by using an adhesive together with spot welding. By improving the strength of the bonded portions, it's possible to reduce the plate thickness and achieve weight reduction.

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

Bringing out aluminum's functionality in vehicle manufacture

Creating new forms to meet the demands of vehicle electrification by fully using expertise as an aluminum materials manufacturer

UACJ Corporation is one of the world's leading rolled aluminum manufacturers. The R&D Center actually goes back to the former Furukawa-Sky Aluminum Corporation and the light metal research team of Sumitomo Metal Industries Co. Ltd. In 1936, Dr. Isamu Igarashi invented ESD (Extra Super Duralumin), the world's strongest aluminum alloy as a material for the production of aircraft.

The UACJ R&D Center has three bases today, in Japan, North America and Thailand, with 300 top researchers from the world's aluminum rolling industry. In the production of cars, aluminum has gradually taken over from steel. The use of aluminum sheets began with bonnets, and was then expanded to body panels, including fenders, trunk lids and doors.

"Capitalizing on our strengths as a manufacturer specializing in aluminum rolled products, our aim is to develop aluminum alloys which are as easy to use as steel and carry out technological developments in a comprehensive manner to support our customers' vehicle production." (Kazuhisa Shibue, Chief Executive, R&D Division)

As for aluminum alloy extrusions, in addition to their light weight and high rigidity, they have attracted attention for their shock absorption characteristics, and their use has been expanded to bumpers and chassis members. Bumper reinforcement ASSY is a typical example of this. The Center designs members, including bumper beams and crash boxes, with an optimal cross-sectional shape using CAE analysis technology.

It also gets involved in development from the viewpoint of a materials manufacturer, thereby contributing to the creation of finished products. With its high heat conductivity and radiation performance, and good corrosion resistance, aluminum is used for most of the heat exchangers of air conditioners, radiators, etc. UACJ has accumulated extensive knowhow for the development of members for heat exchangers, flux-free brazing, and surface treatment technology such as pre-coating.

"As a materials manufacturer with a wealth of experience, we would like to make approaches to customers regarding our greater involvement in the manufacture of vehicles in the future. One example would be use of our coating technology to solve the issue of electrolytic corrosion resulting from the use of multi-materials. Another would be to suggest solutions for surface treatment, putting parts together, and producing them in prescribed shapes." (Yasuhiro Hosomi, Deputy Head of the R&D Center)

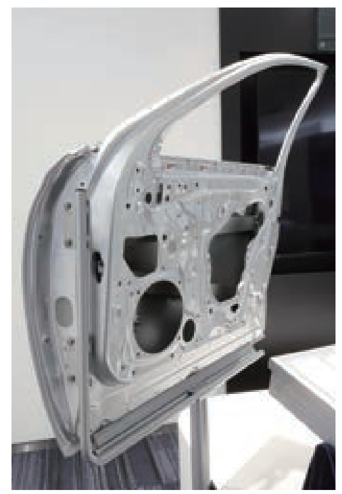
The Innovation Area also displays a battery housing which joins hollow extruded members with a coolant flow channel using FSW (friction-stir welding) technology.

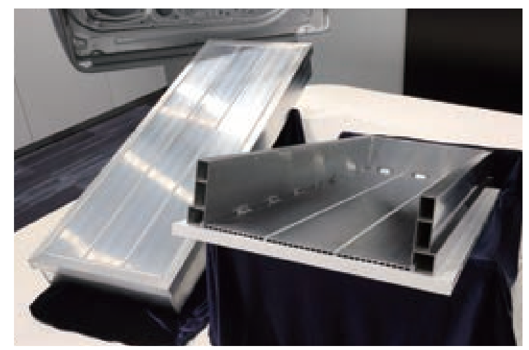
"The many samples on display serve as a springboard for discussion. We would like customers to consider if our products meet their needs for manufacturing vehicles and let us hear all their requests." (Kazuhisa Shibue, Chief Executive, R&D Division)

Aluminum also plays an important role as a material for the lithium-ion batteries which are widely used for peripheral materials, including the electrode foil for current collectors, case materials, bus bar materials, and tab terminal lead materials. Batteries always generate heat as a result of being charged and discharged, so a heat management system to keep the temperature constant is extremely important.

"It's essential to address thermal management. We want to suggest customer-friendly solutions by combining the technologies that we have accumulated over the years." (Yasuhiro Hosomi, Deputy Head of the R&D Center)

As the demand increases to make automobile lighter for the sake of reducing CO_2 emissions, the development of technology using aluminum is in progress. I could see a wide variety of possibilities for aluminum materials through the technologies exhibited in the Innovation Area. Behind the technological developments that play a core role as the driving force for manufacturing vehicles is the engineering spirit cultivated by the UACJ R&D Center.





The open innovation-oriented automobile technology corner provides a wide space for the display of items such as bonnet hoods, bumper reinforcements, and front doors. At the center is a prototype battery housing for power train electrification.

The R&D Center after renewal. Aluminum honeycomb panels are used for the exterior.

UACJ Director and Senior Managing Executive Officer
Chief Executive, R&D Division
Kazuhisa Shibue

UACJ Executive Officer
Vice Chief Executive Research & Development Division
Head of the North America R&D Center
Yasuhiro Hosomi

(Source: Motor Fan illustrated vol.151 2019)

Popular Aluminum Alloys for Automobiles

Various types of aluminum alloys are used for automotive components according to the strength, formability and corrosion resistance required at each point of application.

Alloy series	AA*1 Equivalent alloys	UACJ (by quality)	Tensile strength (N/mm^2)	Proof stress (N/mm^2)	Elongation (%)	Sheet	Extrusion	Characteristics of materials
1000 Al	1085	A85-H26	120		15	✓		Luminous aluminum alloy sheet Surface quality: LF, HB
		A370-O	85		40	✓		Luminous aluminum alloy sheet Surface quality: BF, MF
		A370-H24	120		23	✓		Luminous aluminum alloy sheet Surface quality: BF, MF
2000 Al-Cu	2013	113S-T6	400	375	12		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	2014	2014-T4	420	285	20		✓	High-strength alloy for extrusion
	2014	2014-T6	480	410	13		✓	High-strength alloy for extrusion
	2017	2017-T4	440	275	22		✓	High-strength alloy for extrusion
	2024	2024-T4	470	325	19		✓	High-strength alloy for extrusion
	2014	2014-T6	480	410	13		✓	High-strength alloy for forging Forgeability & machinability: Excellent
		2618-T6	440	370	10		✓	High-strength alloy for forging Forgeability & machinability: Excellent
		CG29-T6	520	400	14		✓	High-strength alloy for forging Forgeability & machinability: Excellent
3000 Al-Mn		3003-O	115	40	40		✓	Alloy for tubing Hollow extrusion performance: Good
4000 Al-Si	4032	4032-T6	380	315	9		✓	Wear-resistant alloy for forging Forgeability, machinability, corrosion resistance: Good
		TF068-T6	380	245	10		✓	Wear-resistant alloy for forging Forgeability, machinability, corrosion resistance: Good
		SC100-T6	440	390	8		✓	Wear-resistant alloy for forging Forgeability, machinability, corrosion resistance: Good
		TF128-T6	430	380	8		✓	Wear-resistant alloy for forging Forgeability, machinability, corrosion resistance: Good
5000 Al-Mg	5052	52S-O	205	105	28	✓		Alloy for body panels n value *2=0.26, r value=0.70
	5182	GM145-O	270	120	28	✓		Alloy for body panels n value *2=0.33, r value=0.55
	5022	GC45-O	280	140	32	✓		Alloy for body panels n value *2=0.31, r value=0.70
	5052	52S-O	205	105	28	✓		High-strength alloy for structural purposes Shear strength: 120N/mm^2
	5454	D54S-O	225	100	27	✓		High-strength alloy for structural purposes Stress corrosion cracking resistance: Excellent
	5154	A254S-O	240	115	27	✓		High-strength alloy for structural purposes Stress corrosion cracking resistance: Good
	5083	183S-O	290	145	24	✓		High-strength alloy for structural purposes Shear strength: 170N/mm^2
	5110A	257S-O	110		30	✓		Luminous aluminum alloy sheet Surface quality: HB, BF, MF
	5110A	257S-H24	150		15	✓		Luminous aluminum alloy sheet Surface quality: HB, BF, MF
	5657	F57S-H26	170		12	✓		Luminous aluminum alloy sheet Surface quality: LF, HB, BF
	5252	B152S-H24	220		10	✓		Luminous aluminum alloy sheet Surface quality: BF
	5154	254S/5154-O	240	117	27		✓	High-strength alloy for extrusion
	5083	5083-O	290	145	25		✓	High-strength alloy for extrusion

*1 AA: The Aluminum Association (U.S.A.)
*2 Average value between 2% and maximum load

*Baking conditions for BH-type alloy for body panels: Test value after applying 2% pre-distortion and 20 min at 170°C

Note: The list is made for each alloy series giving priority to the point of application for automobiles, so some material qualities may be indicated repeatedly. The figures are measures of central tendency, not guaranteed values.

Alloy series	AA*1 Equivalent alloys	UACJ (by quality)	Tensile strength (N/mm^2)	Proof stress (N/mm^2)	Elongation (%)	Sheet	Extrusion	Characteristics of materials
6000 Al-Mg-Si	6116	SG712-T4	240	130	28	✓		Alloy for body panels, High-BH type Proof stress after baking: 205N/mm^2
	6116	SG712-T4	245	135	30	✓		Alloy for body panels, High-forming type Proof stress after baking: 170N/mm^2
	6005	TM30-T4	210	110	27	✓		Alloy for body panels, High-BH type Proof stress after baking: 195N/mm^2
	6111	TM66-T4	240	115	29	✓		Alloy for body panels, High-BH type Proof stress after baking: 210N/mm^2
	6061	561S-O	120	45	34	✓		High-strength alloy for structural purposes Stress corrosion cracking resistance: Good
	6061	561S-T6	315	275	17	✓		High-strength alloy for structural purposes Shear strength: 205N/mm^2
	6111	SG09-T6	260	315	16	✓		High-strength alloy for structural purposes Stress corrosion cracking resistance: Good
	6005C	6N01-T5	260	220	12		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	6061	6061-T6	315	275	19		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	6061	661S/CM61-T6	340	300	18		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
		SG109-T6	310	270	14		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
		GS310-T6	390	365	19		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	6061	6061-T6	315	275	19		✓	High-strength alloy for forging. Forgeability and corrosion resistance: Excellent; Machinability: Good
	6082	6082-T6	325	300	18		✓	High-strength alloy for forging. Forgeability and corrosion resistance: Excellent; Machinability: Good
		SG210-T6	400	360	18		✓	High-strength alloy for forging. Forgeability and corrosion resistance: Excellent; Machinability: Good
7000 Al-Zn-Mg	7003	ZK141-T7	360	280	16	✓		High-strength alloy for structural purposes Shear strength: 190N/mm^2
	7075	75S-T6	570	510	11	✓		High-strength alloy for structural purposes Shear strength: 330N/mm^2
	7003	7003-T5	310	260	16		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	7204	7N01-T5	360	320	14		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	7204	K70Y-T5	415	360	16		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
		ZK55-T6	420	380	14		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	7046	ZK170-T6	450	420	14		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
		ZK80-T6	500	470	14		✓	High-strength alloy for extrusion Hollow extrusion performance: Good
	7075	7075-T6	590	540	14		✓	High-strength alloy for extrusion
	7050	7050/ZG62-T6	620	570	13		✓	High-strength alloy for extrusion
		ZC80-T6	630	580	13		✓	High-strength alloy for extrusion
		ZC88-T6	650	600	13		✓	High-strength alloy for extrusion

UACJ's next-generation aluminum technology

At the UACJ Research & Development Division, comprehensive developments on automobile materials, including aluminum alloy materials, optimization of surface treatment and processing are being carried out.

Corporate Name	UACJ Corporation
Headquarters	Tokyo Sankei Bldg., 1-7-2 Otemachi, Chiyoda-ku, Tokyo 100-0004, Japan
Principal Business	Manufacture and sales of aluminum rolled products, extrusions, cast products, forged products, precision-machined components.
Capital	52,277 million yen (approx. 463 million U.S. dollars)

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