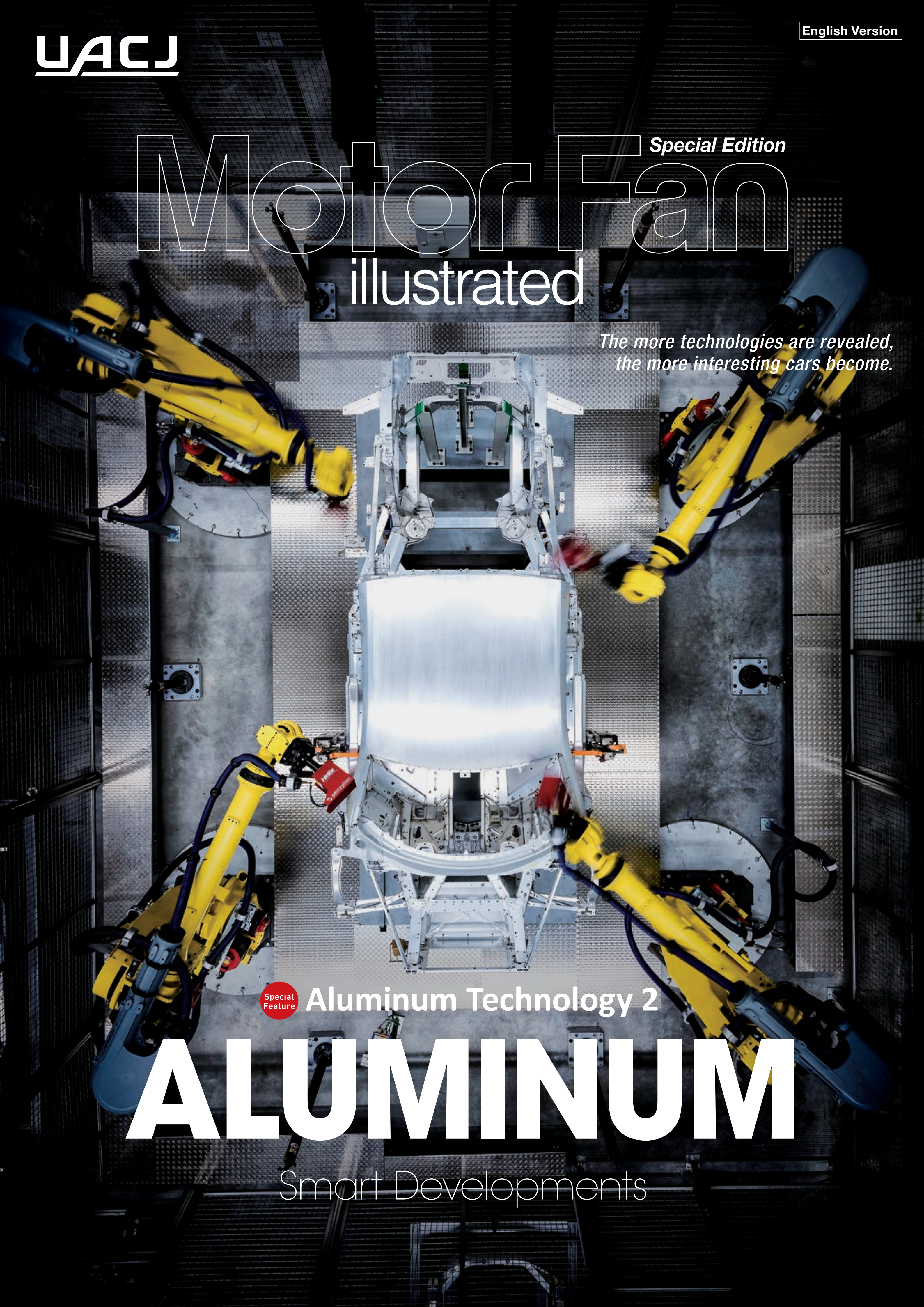
UACJ

English Version

Motor Fan illustrated

Special Edition

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

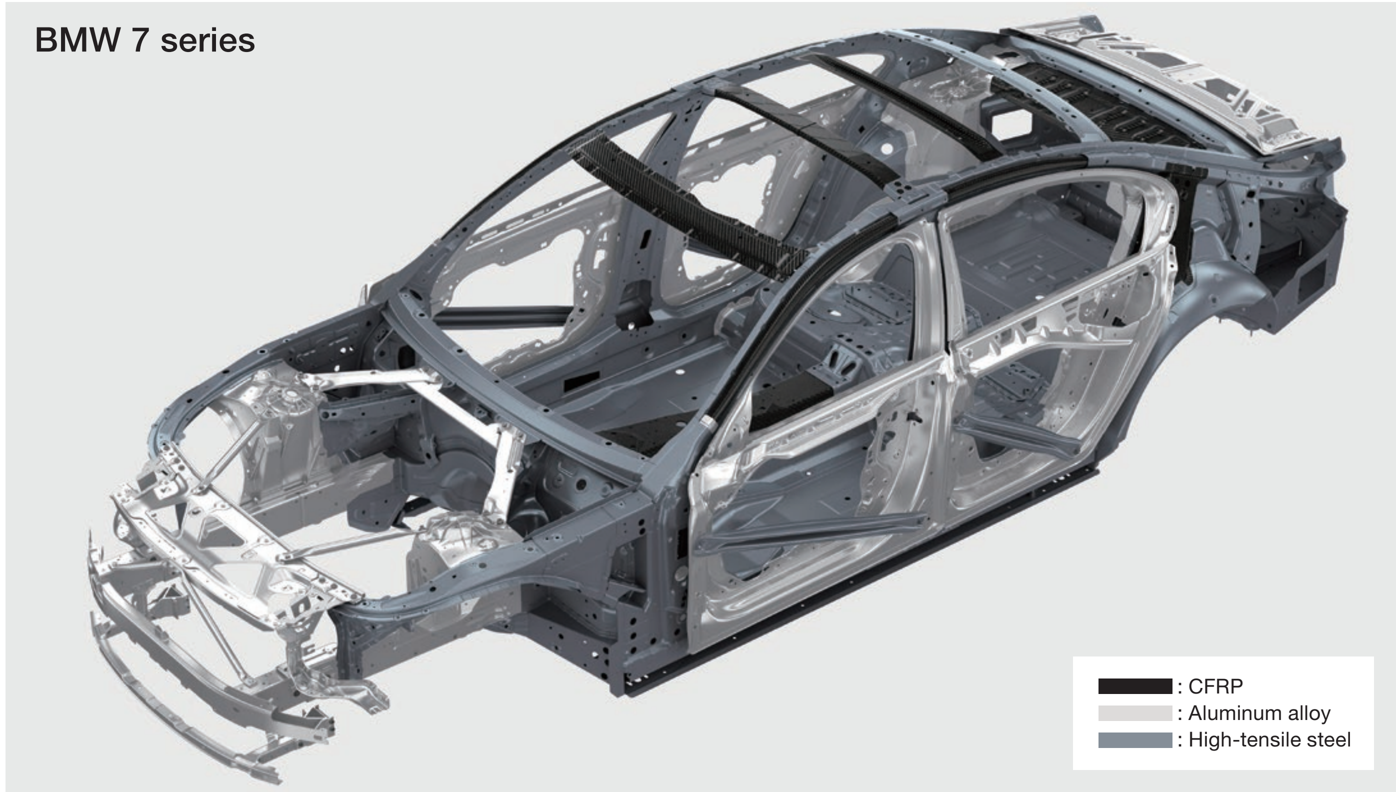


Special Feature **Aluminum Technology 2**

ALUMINUM

Smart Developments

Introduction | Replacing steel with aluminum alloys, anessential way to reduce weight



■ Impact of the Ford F-150

The F-150 is the best-selling vehicle in North America and the core model of the Ford F-Series of pickup trucks. The complete model change conducted in 2014, with a new steel frame clad in aluminum body panels, attracted a lot of attention in the market. The use of aluminum alloys for the cabin and the cargo area reduced the weight by about 230 kilograms. The reduction in the total body weight of about 320 kilograms improved fuel efficiency by up to 20% compared to previous models.

■ Showcase of the multi-material approach

In Europe, there is an intensified trend to use multi-material designs, incorporating steel sheet, aluminum alloys and CFRPs in appropriate places. In the latest BMW 7 Series, the efficient use of steel sheet, aluminum alloys and CFRPs has achieved a reduction of about 130 kilograms in the overall body weight and about 40 kilograms for the framework compared to the previous BMW 7 Series models. Particularly noticeable is the use of aluminum alloys not only for body panels such as the bonnet, doors and trunk lid, but also for structural materials such as engine support brackets, side sills and the crash box.

Weight reduction, a key for clearing fuel consumption regulations

Along with the flow of technological innovation, there have been three waves of interest in using aluminum in the automobile industry. The first wave was the movement around 1990 to reduce weight by using aluminum for the whole vehicle body. The second wave was around the year 2000, replacing materials with aluminum alloy sheet that had mechanical properties equivalent to those of steel sheet. And the third wave is the current trend to reduce weight in order to lower CO_2 emissions.

Weight reduction of a whole vehicle promotes downsizing of the powertrain and improves fuel efficiency. Because the use of aluminum alloys as replacement materials rather than high-performance steels has a greater effect on weight reduction, some vehicles using aluminum alloys for structural components have entered the market.

The use of aluminum in vehicles continues to advance, centered around luxury cars in Europe. In the case of the F-150 pickup truck, which is a large, heavy and mass-produced model, an improvement in fuel efficiency of about 20% was achieved, and it meets the strict CAFE regulations.

Another trend in the search for weight reduction favored by European automobile makers is the multi-material approach, using steel, aluminum alloys, CFRPs, and other materials in appropriate places.

The environment surrounding automobiles today is different from that at the times of the first and second waves of interest in aluminum. The need for using aluminum is growing greater, so the third wave may develop into a big surge.

Region	Approach
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 54.5mpg (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

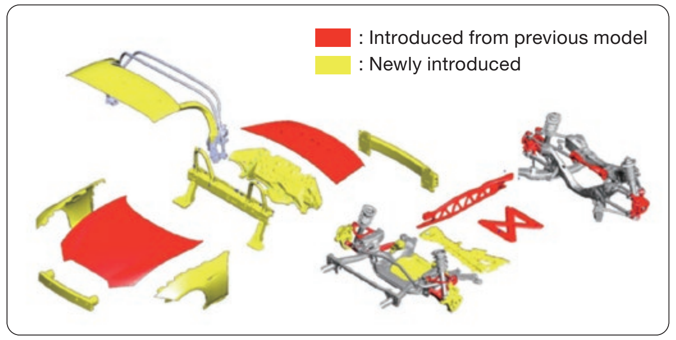
Case Study 1 | Mazda MX-5 | The role played by aluminum alloys in weight reduction

Thanks to the review of the design basics, the new Mazda MX-5 sports car achieved a weight reduction for the body and chassis, making the curb weight less than 1 ton. Weight saving was possible in three areas: 1. Downsizing of the body and powertrain; 2. An innovative body structure; 3. The introduction of lightweight materials.
In the development of the body shell, weight reduction was attempted by replacing the materials with optimal ones while maintaining the strength of the body components. As a result, a weight reduction of 23 kilograms was achieved compared to the previous generation.
Introducing high-tensile and ultra-high tensile steel was also effective in reducing weight, but in fact 53% of the total reduction of 23 kilograms was thanks to the replacement of materials by aluminum alloys.
7000 series high-strength aluminum alloys have been used for the first time in Japan for the front bumper of the new Mazda MX-5. Using aluminum for reinforcement of both front and rear bumpers has achieved a weight reduction of 4.1 kilograms compared to the previous materials.
Mazda Motor Corporation traditionally designs each component with a thorough consideration of weight reduction, employing its 'gram strategy' approach. As a result, many components have undergone weight reduction ranging from several grams to dozens of grams. Replacing materials with aluminum alloys has proved to be a very effective part of this strategy.

Mazda MX-5 (ND)

■ **Front fender (Steel→Aluminum alloys)**

Aluminum alloy sheet for body panels was first used for bonnets in Japan for the MAZDA RX-7 in 1985. Since then, 5000 and 6000 series aluminum alloys have been used for body panels.



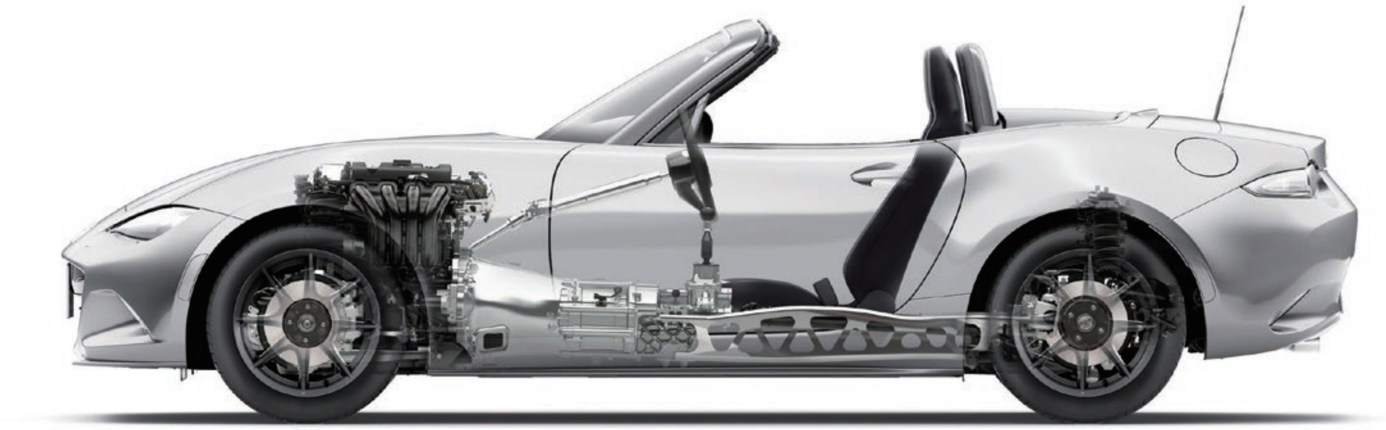
■ **Major points of application for aluminum materials on the MX-5**

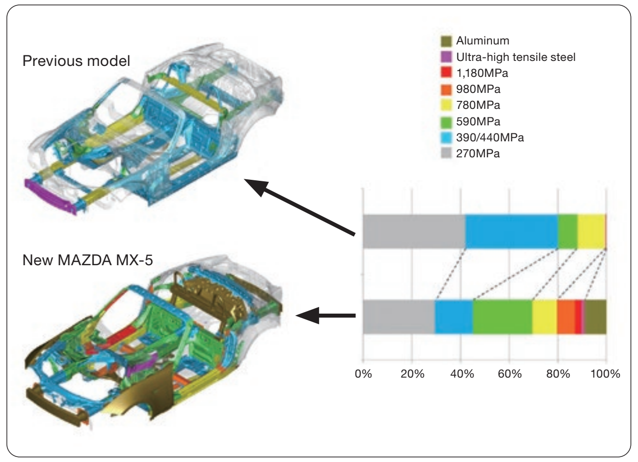
In the new MAZDA MX-5, aluminum has been employed for the front fenders, bumper reinforcement, the bulkhead and the front knuckle, in addition to the bonnet and trunk lid.

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.

In all the crash tests, including small overlap tests, the Ford F-150 has been evaluated as GOOD, the highest score.





■ **Previous→New Comparison of materials**

Aluminum alloys have been widely used in the new MAZDA MX-5 to create a light but highly rigid body. The percentage of their use has increased to 9% compared to 0.1% in the previous models.

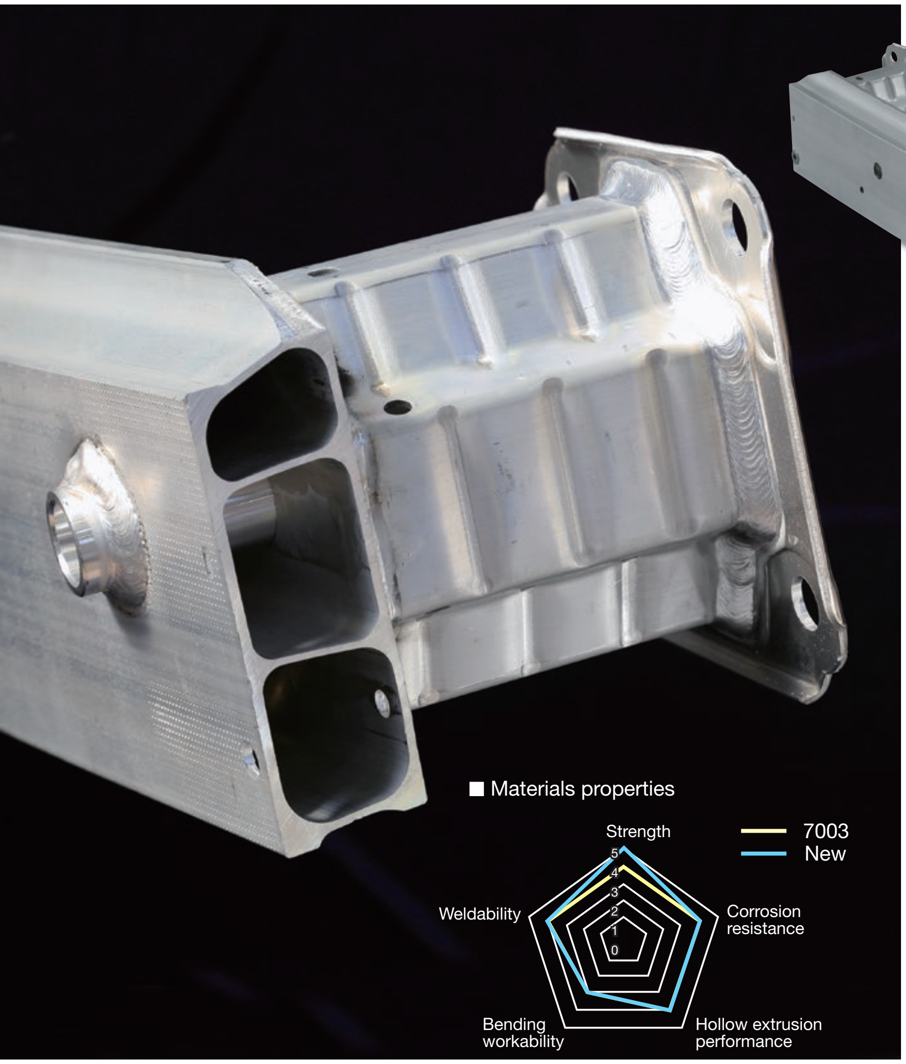
■ **Aluminum alloy front bumper**

The new MAZDA MX-5 front bumper reinforcement uses a 7000 series high-strength aluminum alloy newly developed by UACJ.

■ **Aluminum alloy power plant frame**

The power plant frames used for several generations of MX-5 models are press-formed products made of 6000 series high-strength aluminum alloy sheet for structural purposes produced by UACJ.

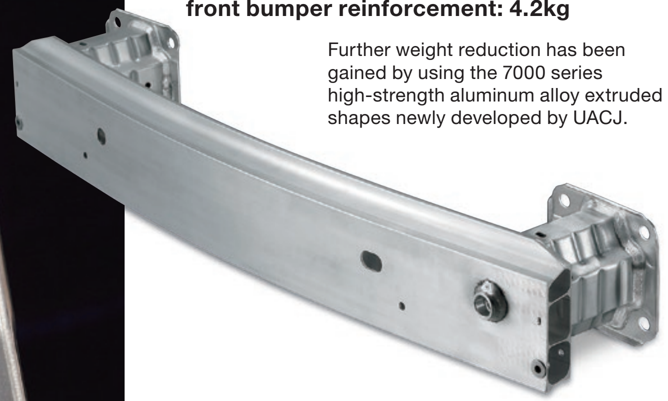
Case Study 2 Aluminum Bumper | Development of an aluminum alloy bumper for the MX-5



■ 7000 series high-strength aluminum alloy reinforcement

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

■ Mazda MX-5 4th Generation (ND) aluminum front bumper reinforcement: 4.2kg



Further weight reduction has been gained by using the 7000 series high-strength aluminum alloy extruded shapes newly developed by UACJ.

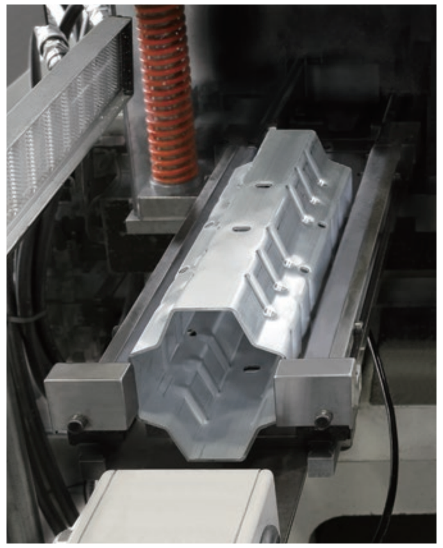
■ Mazda MX-5 3rd Generation (NC) steel front bumper reinforcement: 5.8kg

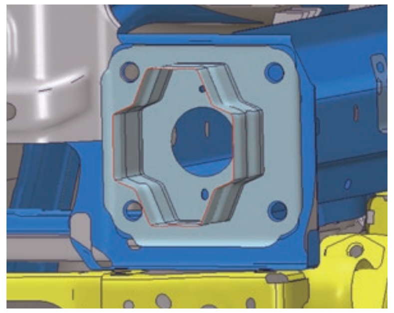
In consideration of reducing weight and protecting passengers in a full-wrap frontal crash or offset crash, the previous MX-5 models with a compact body used ultra-high tensile steel.

■ Mazda MX-5 2nd Generation (NB) steel front bumper reinforcement: 2.86kg

The front bumper reinforcement for the MX-5 2nd Generation (NB) was a simple structure made of steel with a resin cover, but it met the collision safety standards of the day.
Note: The crash box is included in the weight of the MX-5 4th Generation (ND) and the MX-5 3rd Generation (NC).

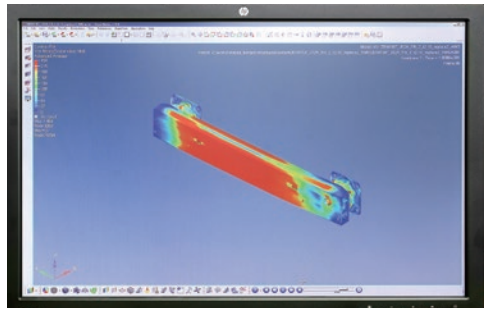
Among the aluminum components used for the new Mazda MX-5, the bumper reinforcement is of special interest. In order to meet the increasingly strict collision safety standards, the performance required for front bumpers is becoming very high. Regarding the new MX-5, further weight reduction was achieved while at the same time securing a safety performance of the highest level. Reducing the weight of the components which are the furthest from the vehicle's center of gravity is effective not only for improving fuel efficiency but also for increasing maneuverability.
In order to make the best use of the superiority of aluminum alloys, MAZDA and UACJ jointly carried out a zero-base examination from materials properties through to construction methods. MAZDA took the measure of using 7000 series high-strength aluminum alloy extruded shapes. The bumper reinforcements using extruded shapes were made thicker where necessary and made to appropriate a cross-sectional shape where extra strength is not required, resulting in a drastic weight reduction. The MX-5 also secured weld properties so that components could be combined by welding, thereby increasing the level of their strength.
The next task was the design of the curve of the car's beautiful front end. Bumper reinforcements using extruded shapes are usually linear in shape, and it's not easy to form 7000 series high-strength extruded shapes into an arc-like shape. An automated manufacturing line featuring the stretch bending method that was developed exclusively for MX-5 production solved that difficult issue, and the reinforcement was successfully installed in the front bumper, which requires collision safety performance.
The crash box, a part made of aluminum alloy with a cruciform cross-section that is joined to the bumper itself, gets crushed like a bellows to absorb impact energy. To realize an optimal design and processing of these shapes, knowhow integrating simulation technology, materials and processing technologies, and other technologies was introduced. The UACJ Group's forte is its integrated systems all the way through from the development of materials and processing technologies to manufacturing.





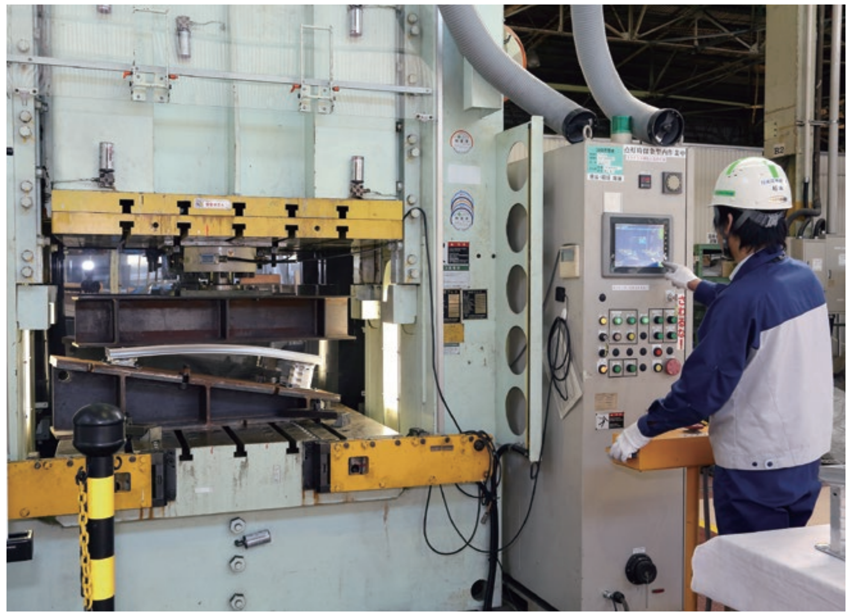
■ Cruciform cross-sectional shape

A cruciform cross-sectional shape is used for the front frame crash box.



■ CAE for bumper beam

The mechanism of distortion has been analyzed using CAE to determine the best cross-sectional shape for aluminum extruded shapes that are excellent in terms of both strength and absorption of impact energy.



■ Performance evaluation tests

The experimental values gathered from a stationary test continued until a crash box is completely smashed and an impact test are compared with CAE analytical values.

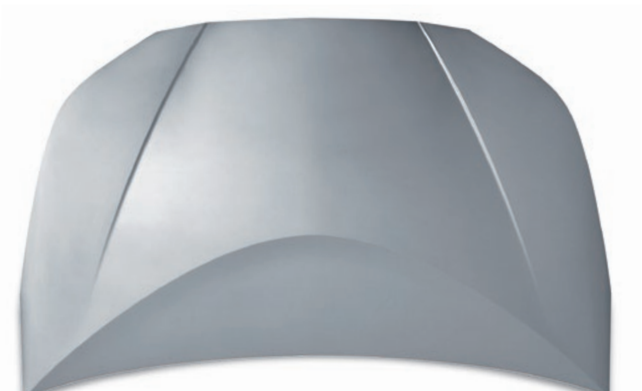
■ Integrated manufacturing line from aluminum extrusion

The UACJ's forte is its integrated system, all the way through from the development of aluminum alloys to shape design and processing techniques.

Case Study ③ Toyota Prius | Why aluminum alloys are used for the best-selling HEV model

TOYOTA PRIUS

Toyota's 4th generation Prius, which debuted in 2015, is a hybrid electric vehicle that is the best-selling model worldwide. It features a fuel efficiency performance of the world's highest standard. In the same way as with the 3rd generation, the bonnet and tailgate are made of aluminum alloys.



■ Bonnet

Both the interior and exterior structures of the bonnet for the 4th generation Prius are made of 6000 series aluminum alloy sheet. 6000 series alloys have the property of 'bake hardenability' which enhances proof stress thanks to the elevated temperatures during the coat baking process.

■ Tailgate

Both the interior and exterior structures of the tailgate for the 3rd generation Prius are made of 6000 series aluminum alloy sheet.

6000 series aluminum alloys have been used for the bonnet and tailgate for both the 3rd and 4th generations of Prius. The bonnet and tailgate are important components located at the upper front and rear end of the car body, so the introduction of aluminum alloys has had a significant effect on weight reduction, as well as improvement of fuel efficiency and driveability.

On the other hand, aluminum alloys are inferior to steel in terms of formability. To use aluminum alloys for body panels, properties that rebel against each other, such as light weight, strength and easy press forming, have to be achieved at a high level.

In addition to strength and formability, the properties required for body panels include hemmability, which joins the interior and exterior structures by bending, dent resistance, corrosion resistance, and a high-luster paint finish.

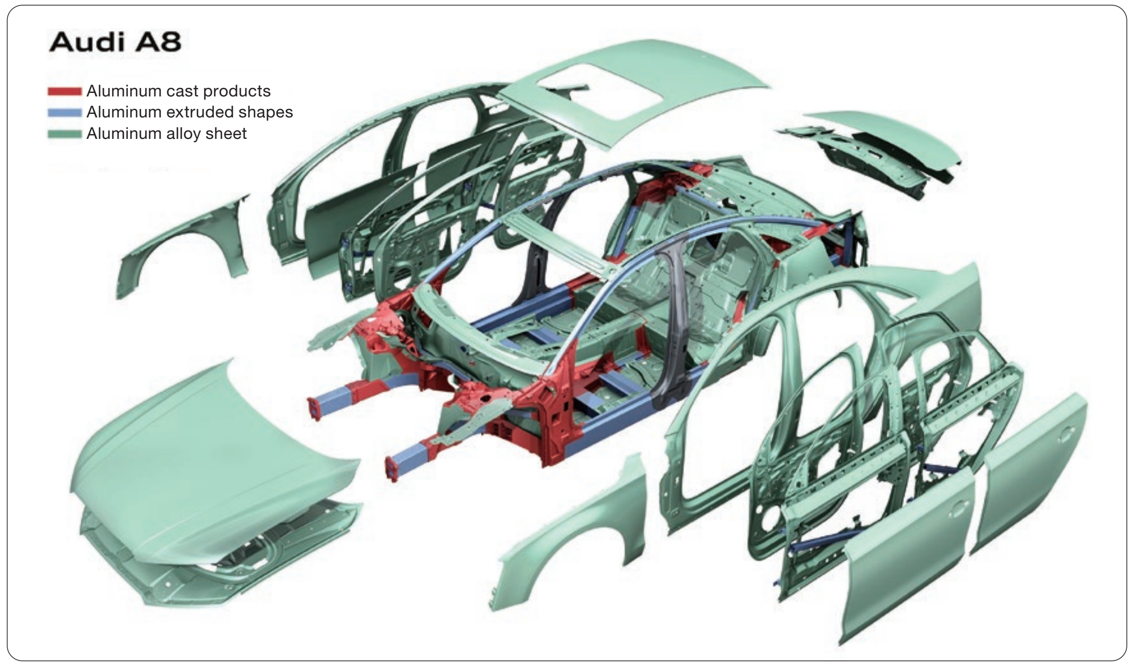
The UACJ 6000 series aluminum alloy sheet used for the Prius is excellent in 'bake-hardenability', which enhances proof stress after the coat baking process. This makes it an ideal aluminum alloy sheet for body panels.

■ Major points of application for aluminum alloys on the AUDI A8

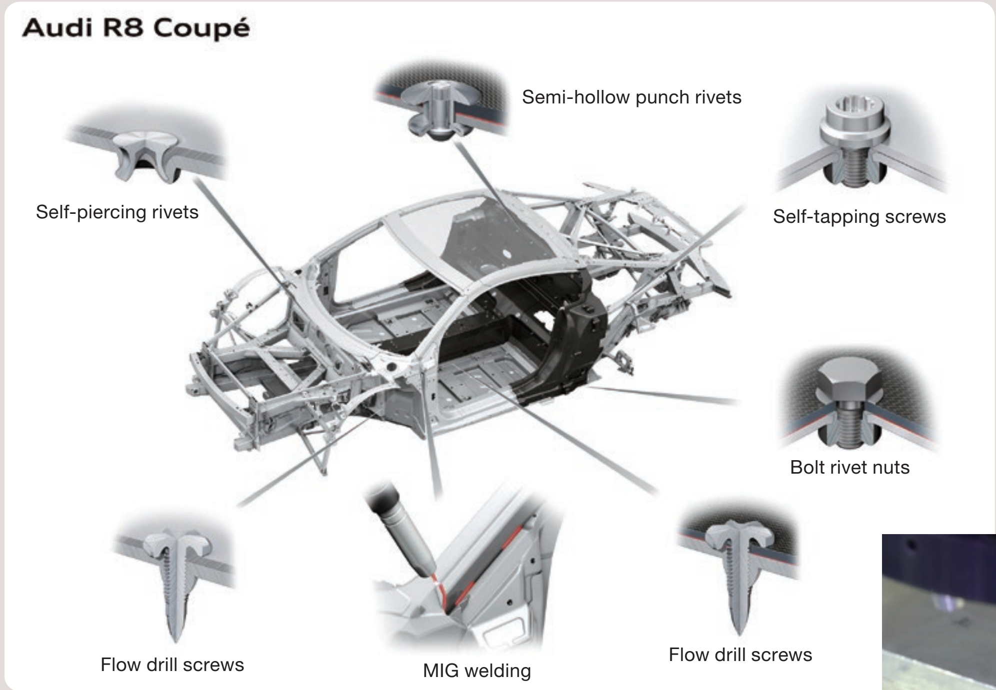
■ Red
Aluminum cast products used for the strut mounts, A pillar bases, etc.

■ Blue
Aluminum extruded shapes used for side members, side sills, floor panels, etc.

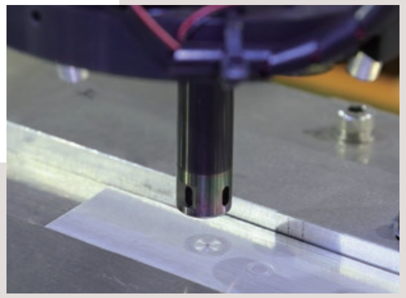
■ Green
Aluminum alloy sheet used for most of the outer panels, including the doors, trunk lid, and bonnet.



Joining Technology for Aluminum Alloys



Various types of joining methods for aluminum have been developed and put to practical use, ranging from MIG welding and YAG laser welding to mechanical joining and binding.
The AUDI R8 adapts different types of joining tools and methods, such as flow drill screws, punch rivets, mechanical clinching, MIG welding, and binding according to the points of application.



■ FSW/FSSW

Friction stir welding (FSW) is a joining method that intrudes materials by rotating a cylindrical tool with a pointed tip, softening the parent metal with frictional heat, and tempering the material using the plastic flow around the joint area.

Development

The Future of Aluminum with UACJ R&D

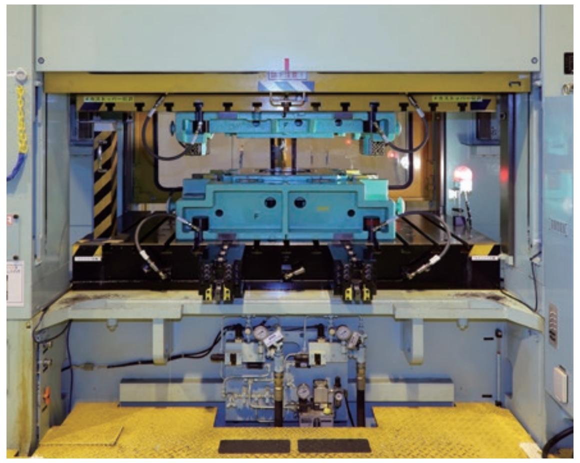
UACJ is a Japanese manufacturer of flat rolled products established in 2013 when Sumitomo Light Metal Industries and Furukawa-Sky Aluminum merged their business operations. In terms of annual capacity of flat rolled products it is ranked 3rd in the world, following Alcoa and Novelis.

Ultra super duralumin (A7075) was invented in 1936 by Dr. Igarashi who worked for Sumitomo Metal, the predecessor of UACJ. UACJ's technological development has been contributing to state-of-the-art transport and construction, containers and packaging, and the manufacture of electrical machinery and other items. UACJ's engineers are constantly at work behind the scenes in the pursuit of technological innovations. Today, as global standards for realizing better fuel efficiency grow ever stricter, the potential of aluminum, the lightweight and eco-friendly metal, is being re-evaluated in the automotive field.

The UACJ Research and Development Division is a world-class integrated research facility for aluminum that focuses on the R&D of aluminum materials for automobiles as well as technological developments to promote their use. The UACJ Group has an extensive global network system to supply products worldwide.

Corporate Name	UACJ Corporation
Headquarters	Tokyo Sankei Bldg., 1-7-2 Otemachi, Chiyoda-ku, Tokyo 100-0004, Japan
Name and Title of Representatives	Shigenori Yamauchi, Representative Director & Chairman of the Board Mitsuru Okada, Representative Director & President
Principal Business	Manufacture and sales of aluminum rolled products, cast products, forged products, precision-machined components and copper tubing.
Capital	45 billion yen

Field-Emission Transmission Electron Microscopy (FE-TEM): Observation and analysis of the crystal structure of aluminum materials



Large servo press testing devices: Research on die shapes for press forming and the forming process for body panels

■ The UACJ Research and Development Division

Location: Nagoya, Aichi Pref., Japan

With the world's top level of capability in the development of 6000 series aluminum alloys for body panels, the R&D Division is working on the development of materials and application technologies to match automotive components of every kind.

■ Fukaya Center, R&D Division

Location: Fukaya, Saitama Pref., Japan

Equipped with analyzers, evaluation apparatus for large presses and other items, as well as machinery for trial manufacture, the Fukaya Center works on the development of fundamental technologies for aluminum materials.

The UACJ Research and Development Division

Fukaya Center, R&D Division

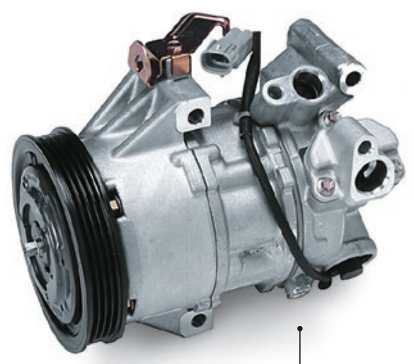
Contactless Coordinate Measuring Machine: Measures the cross-sectional shapes, etc., of automotive parts

Automotive components that use aluminum alloys

Lightweight aluminum alloy materials are used for engines, engine accessories and suspension-related components.

[Air Conditioner]

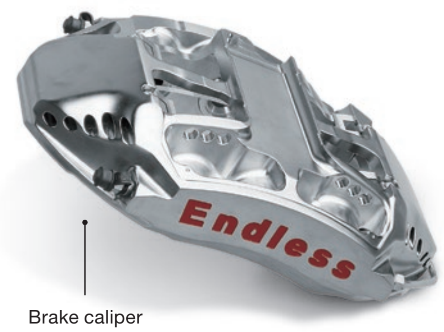
The compressor, which is the heart of a car air conditioner, comes in various types, including the swash plate type, vane type and scroll type, and aluminum die-cast products are frequently used. The use of high-strength aluminum forged products in the most popular swash plate type of compressor pistons contributes to downsizing and enhanced performance. Aluminum alloys for heat exchangers are used for condensers and evaporators.



Air conditioning compressor

[Brake Calipers]

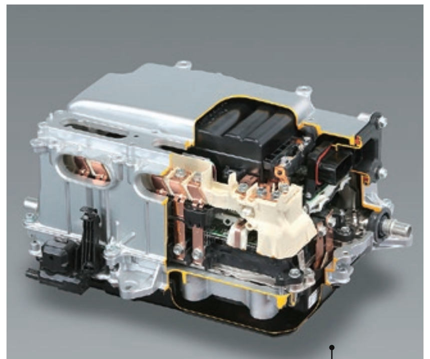
With their role of pressing the brake pads against the brake rotors with the pistons, the brake calipers are a vital security component. Racing cars and sports cars use aluminum forged brake calipers which display high braking performance in high-speed and heavy-load conditions. The brake components are exposed to high temperatures because of the frictional heat caused by the pads and rotors. UACJ produces aluminum forged materials with an excellent design which are very strong and wear-resistant at high temperatures.



Brake caliper

[Power Control Unit]

The power control unit adjusts the electric power source and voltage properly, converting between direct current and alternating current. Hybrid vehicles and electric vehicles powered by electric motors are equipped with a power control unit that consists of an inverter, a boosting converter, a DC/DC converter and other components in order to control the power. Supporting these components is a double-sided cooled power module made of aluminum alloy sheet.



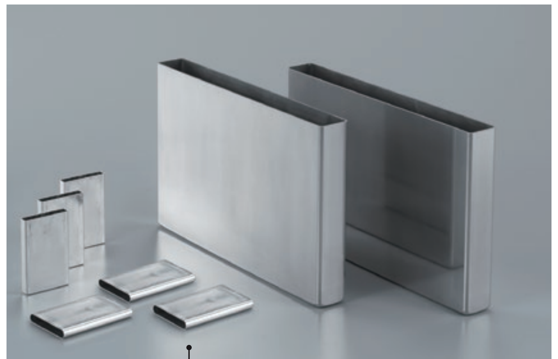
Inverter / Converter unit

[Lithium-ion Batteries]

Lithium-ion batteries (LIB) are compact, lightweight and can provide high voltage, so they are widely used in fields ranging from smartphones to automobiles. As of today, there are no materials to replace the aluminum foil used in the positive electrode. High-strength aluminum alloy sheet that is excellent for deep-draw forming is used for battery cases.

Lithium-ion battery

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



Battery cases

[Heat Exchangers for Automobiles]

The aluminum alloys that predominate in heat exchangers for automobiles contribute to downsizing, weight reduction and raising the functionality of vehicles. Many heat exchangers are produced using aluminum fins and small-diameter aluminum tubes clad with brazing material.
Radiators are heat exchangers that emit engine heat to maintain the temperature at a more or less fixed level. Likewise, the heater core is a small radiator that uses engine heat.
Condensers are the components of the air conditioner and heat exchanger that discharge the heat of the refrigerant gas in high-temperature and high-pressure conditions, and liquefy it.
On the other hand, evaporators are heat exchangers that vaporize liquefied refrigerant.
Intercoolers (Charge air coolers) are engine accessories that cool down high-temperature air by compressing a supercharger.

Automotive heat exchangers

[Shock Absorbers]

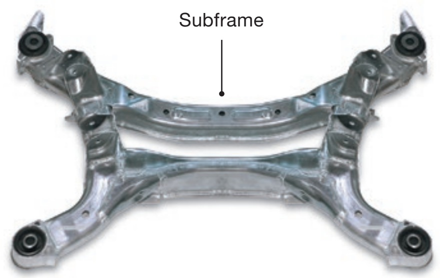
Shock absorbers made of high-strength aluminum alloys have been developed for racing cars and sports cars. The mainstream tube-shaped type of shock absorber can achieve damping because of the resistance created in the oil flow passage. The mono-tube style has a single-walled structure inside the cylinder, and the oil and gas chambers are separated in series by a floating piston. The twin-tube style has a dual structure with exterior and interior tubes; the lower parts of the interior and exterior tubes are filled with oil and the upper part of the exterior tube is filled with gas.

Shock absorbers

[Subframe]

A subframe is the skeleton structural component which carries the powertrain, drivetrain, etc. and is combined with the body frame. It's responsible for bearing the load from the road surface in vertical and horizontal directions.
High-strength aluminum alloy sheet and extruded shapes for structural purposes are used for subframes as both weight reduction and enhanced rigidity are required.

Subframe



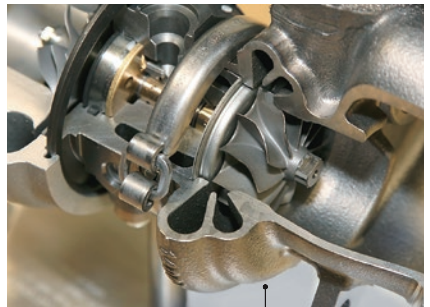
[Suspension Arm/Link]

The suspension arm/link is a structural component which determines the position of the wheels, conveys power from the wheels to the body, and shapes the movement of the suspension to stabilize the body. Use of aluminum alloys for suspension components, including hub carriers, steering knuckles, etc., is spreading because it can drastically reduce the unsprung weight.

Suspension arms

[Turbochargers]

A turbocharger is a device which consists of a turbine and an impeller. The turbine is driven by the engine exhaust gas, and it rotates the impeller to compress the air flowing into the engine. Precisely cast aluminum alloy is the mainstream for impellers and the ones produced by UACJ's Casting and Forging Business hold the world's top share. Impellers produced by machining are also increasing.



Turbocharger

Compressor wheel (Impeller)

Popular Aluminum Alloys for Automobiles

Types, mechanical properties and characteristics of materials

Various types of aluminum alloys are used for automotive components according to the strength, workability 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 series	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 series	2014	114S-T6	480	410	13	○		High-strength alloy for structural purposes Shear strength: $290N/mm^2$
	2017	17S-T4	425	275	22	○		High-strength alloy for structural purposes Shear strength: $260N/mm^2$
	2024	24S-T3	480	340	18	○		High-strength alloy for structural purposes Shear strength: $275N/mm^2$
	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 series		3003-O	115	40	40		○	Alloy for tubing Hollow extrusion performance: Good
4000 series	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 series	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
	5023	GC55-O	285	130	34	○		Alloy for body panels n value *[2] =0.35, r value=0.80
	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

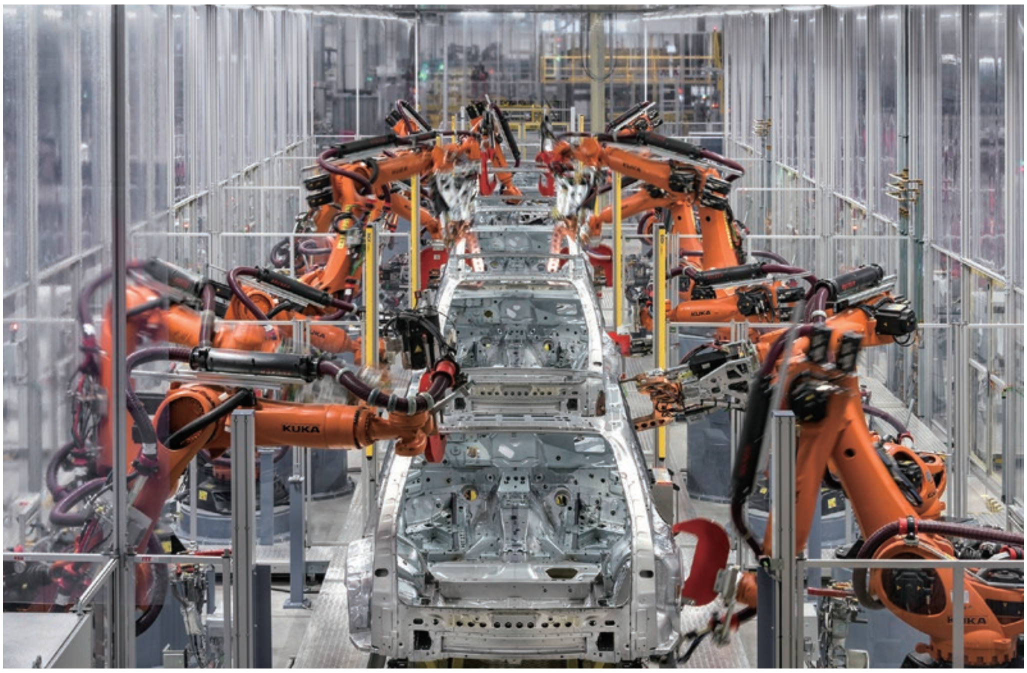
Alloy series	AA*[1] Equivalent alloys	UACJ (by quality)	Tensile strength (N/mm^2)	Proof stress (N/mm^2)	Elongation (%)	Sheet	Extrusion	Characteristics of materials
6000 series	6016	SG112-T4	230	120	27	○		Alloy for body panels, High-BH type Proof stress after baking: $195N/mm^2$
	6016	SG212-T4	240	130	28	○		Alloy for body panels, High-BH type Proof stress after baking: $205N/mm^2$
	6016	SG212-T4	245	135	30	○		Alloy for body panels, High-forming type Proof stress after baking: $170N/mm^2$
	6111	SG312-T4	245	120	30	○		Alloy for body panels, High-forming type Proof stress after baking: $200N/mm^2$
	6005	TM30-T4	210	110	27	○		Alloy for body panels, High-forming type Proof stress after baking: $195N/mm^2$
	6111	TM66-T4	240	115	29	○		Alloy for body panels, High-forming type Proof stress after baking: $210N/mm^2$
	6111	TM67-T4	255	120	29	○		Alloy for body panels, High-forming type Proof stress after baking: $215N/mm^2$
	6111	TM67-T4	285	145	29	○		Alloy for body panels, High-forming type Proof stress after baking: $175N/mm^2$
	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 series	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

*[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.

UACJ



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UACJ Corporation

The largest manufacturer of rolled aluminum products in Japan, UACJ was established by the integration of Furukawa-Sky Aluminum Corp. and Sumitomo Light Metal Industries, Ltd.

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