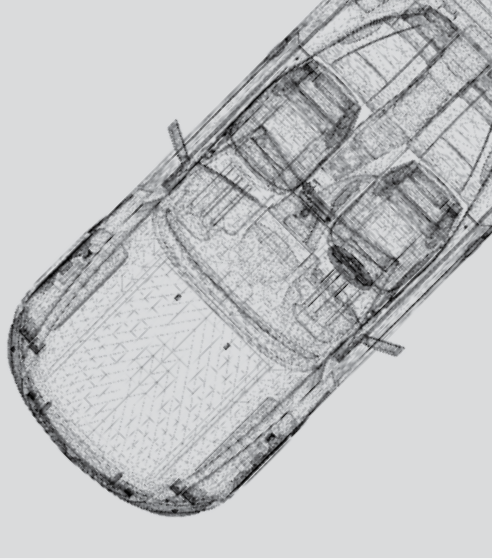


WHEN IT COMES TO
ALUMINUM VEHICLES,
LESS IS MORE

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When It Comes to Aluminum Vehicles, Less Is More

Compare two identical vehicles with equal stiffness and load-carrying capacity—one made of aluminum, the other of steel. Because aluminum has one-third the density of steel, the aluminum vehicle body will be up to 45% lighter. This gives aluminum vehicles multiple advantages, in terms of energy efficiency, reduced emissions, improved ride and handling, better accelerating and braking, increased durability, safety, circular economy benefits...the list goes on.

Here are some of the reasons why less is actually more:

Because aluminum has one-third the density of steel, the aluminum vehicle body will be up to 45% lighter.

LESS WEIGHT = MORE EFFICIENCY

It's just physics that lighter vehicles use less power than heavier ones to do the same journey. Lighter internal combustion engine (ICE) vehicles have better mileage, consume less fuels, and produce less emissions. Battery electric vehicles (BEVs) don't run directly on fossil fuels, but they still require energy to move. Less weight in the vehicle body means they can achieve the same range with smaller batteries and less power. Fewer batteries also translate to less extraction of raw materials and chemicals in the manufacturing stage. And that's not all: lightweighting with aluminum generates secondary weight savings and less material use for other related vehicle systems.

LESS WEIGHT = MORE SECONDARY SAVINGS

When using aluminum to lightweight the vehicle body and closures, you start a virtuous circle of secondary lightweighting. A lighter body means the car can use smaller brakes, suspension parts, motors, or batteries to give the same acceleration, driving performance, and range, with less emissions overall.

This means that in addition to primary weight savings of, for example, 160 kg (achieved by replacing 400 kg of steel with 240 kg of aluminum), the vehicle maker will typically achieve another 40 to 60 kg savings in the weight of other materials throughout the vehicle.

These secondary weight savings are also linked to cost and carbon emissions savings. In the case of BEVs, where the batteries make up a significant cost, the reduced battery pack size can give cost savings that compensate for the material cost increase from replacing a steel body with aluminum.

LESS WEIGHT = MORE SAFETY

In the unfortunate event of an accident, few would disagree that it is safer to be in a bigger vehicle than a smaller one. Since large vehicles are often heavier than small ones, a common misconception is that heavy cars are safer than light ones. However, this is not supported by evidence. For the same vehicle dimensions, a lightweight aluminum vehicle can even be safer for the occupants than a comparable steel-based vehicle.



The key to protecting the occupants in a crash event is to absorb the kinetic energy in a controlled manner and prevent intrusion into the occupant safety cell. Vehicle body structures in aluminum perform both of these functions exceedingly well—and since the vehicle is lighter overall, there is also less energy to be absorbed. This safety performance is well-illustrated by data showing that every aluminum-intensive vehicle (AIV) on the road today has earned a 5-star NCAP safety rating, something that cannot be said for all steel-intensive vehicles (SIV).

In addition to being safer for the vehicle occupants, an AIV is safer for everyone else: occupants of other vehicles, cyclists, and pedestrians. A lighter vehicle with a better dynamic response can avoid accidents more easily. Moreover, reducing vehicle weight reduces the loads on the occupants of any vehicles involved in an accident. With better crash crush performance, more energy can be absorbed over a longer duration, leading to lower peak forces in an accident, which is important for occupant injury reduction.

LESS WEIGHT = MORE DURABILITY

Since aluminum vehicles are lighter, they create less friction on key components such as the tires and brakes. With less friction, materials such as rubber and plastic emit fewer particle emissions. And moving parts experience less wear and tear, for a longer vehicle lifespan.

LESS CORROSION = MORE YEARS IN SERVICE

Automotive grades of aluminum alloys are inherently passive and less prone to corrosion due to the self-healing, protective oxide barrier which forms in milliseconds when cracked, dented, or deformed. Aluminum can safely be used with no protective coatings, even in severe environments, if all the design guidelines are followed. Automotive steel grades, on the other hand, are inherently susceptible to rust, and rely on corrosion protection systems for their durability. While corrosion protection coatings for steel have significantly improved over the



years, their ultimate durability remains limited, and once corrosion starts, steel panels are then perforated by oxidation. In corrosive environments near a coast or in cold regions with road salting, this effect can be seen on relatively new vehicles where corrosion can cause perforation of the body panels in just a few years. In contrast, you will never see an AIV with corrosion that extends beyond the top surface layer.

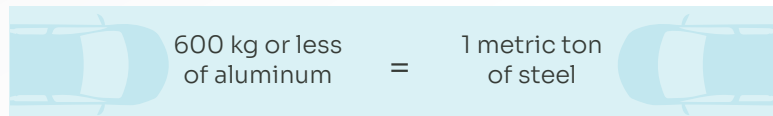
LESS WEIGHT = MORE PAYLOAD

Less weight in the vehicle body translates to an increase in payload and towing capacity for pickup trucks, SUVs, and last mile delivery vehicles. In short, when a vehicle is 450 kg lighter, it can either carry 450 kg more cargo for the same gross vehicle weight, or else overall vehicle weight can be reduced for the same payload (with the potential for reduced impact on the roads and environment).



LESS COMPLEXITY = MORE EFFICIENCY IN MANUFACTURING

When manufacturing vehicles, a greater number of parts equals greater complexity. While steel vehicles are generally made from stamped sheet, aluminum vehicles can be made from a combination of stamped sheet, extrusions, rolled parts, and castings, for fewer total parts. In other words, AIVs require less tools, less robots, less joints and joining technologies, less energy, less factory emissions, less inventory, less capital, and less sealers. And automotive manufacturers only need to use 600 g or less of aluminum for every kilogram of steel.



Likewise, the fewer parts used to make a vehicle, the fewer parts that need to be designed and developed at the start of the process, and the fewer to take apart at the end of its life, allowing for faster disassembly and simpler end-of-life recycling.

LESS WASTE = MORE CIRCULARITY

Aluminum is the most sustainable choice for automotive sheet, because it is infinitely recyclable without a loss in its qualities, including lightness, durability, and formability. More than 90% of a vehicle's aluminum can be recovered and recycled—so an aluminum car at the end of its life can be recycled and practically made into another car.

Recycling aluminum uses only ~5% the energy of producing primary metal, and reduces carbon emissions by up to 95%.

Recycling aluminum uses only ~5% the energy of producing primary metal, and reduces carbon emissions by up to 95%. Recycling aluminum scrap in a closed-loop process allows vehicle manufacturers to reduce their carbon emissions immediately, while end-of-life recycling offers an opportunity for future reductions.

Steel is also recyclable, but it melts at around 1400°C, whereas aluminum has a less energy-intensive melting point of 650°C. Since vehicles can be manufactured with 600 kg (or less) of aluminum for every metric ton of steel, the energy savings of aluminum are even better.

What's true for minimalism is also true for mobility: less is definitely more.



Alumobility is a global ecosystem of leading aluminum and downstream technology partners that supports automotive manufacturers in creating lighter, safer, smarter, and more sustainable vehicles. The non-profit association was founded to focus on technical studies to advance the adoption of aluminum body sheet (ABS). Alumobility is helping to fulfill the promise of a lighter, more efficient, more sustainable mobility future.

For more information on our studies and events, visit alumobility.com or contact us at info@alumobility.com.

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