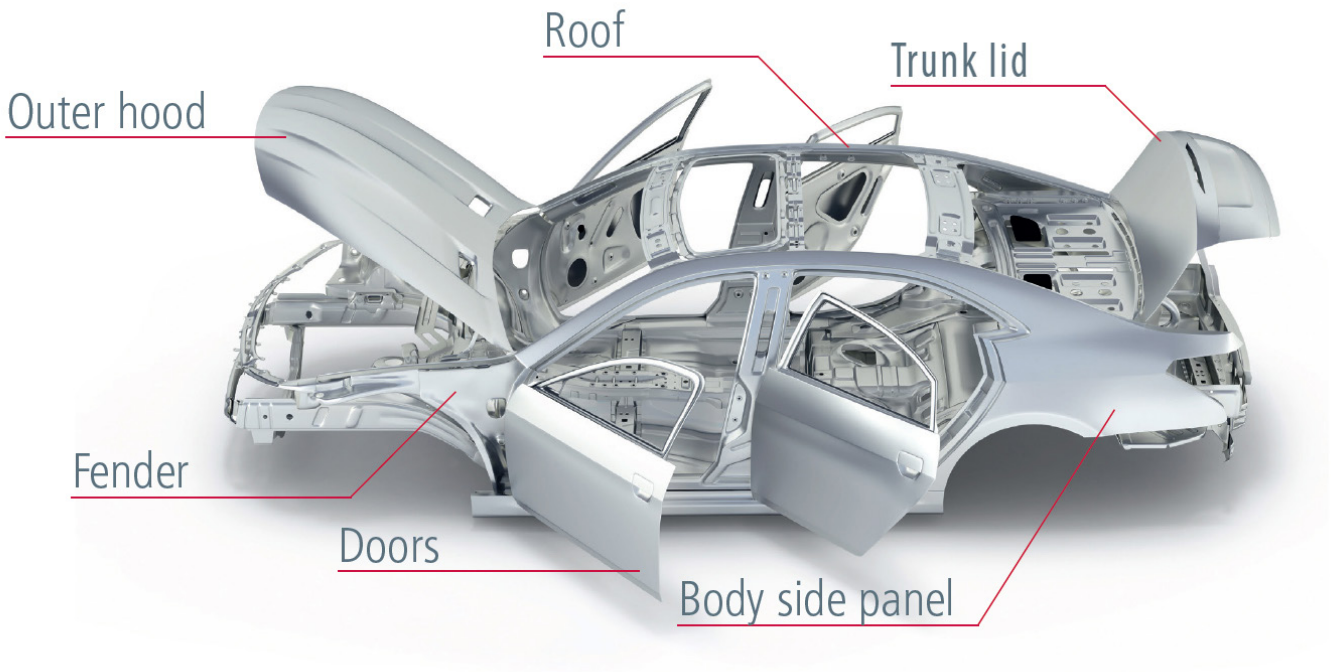
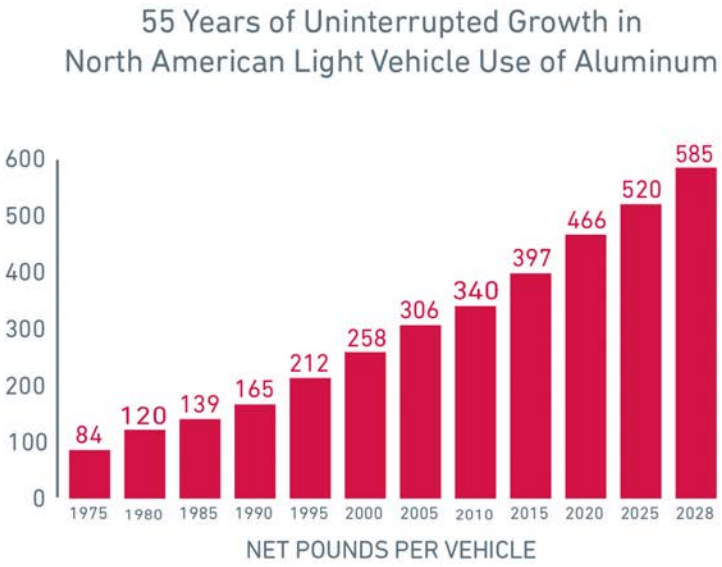
Automotive lightweighting with aluminum closures

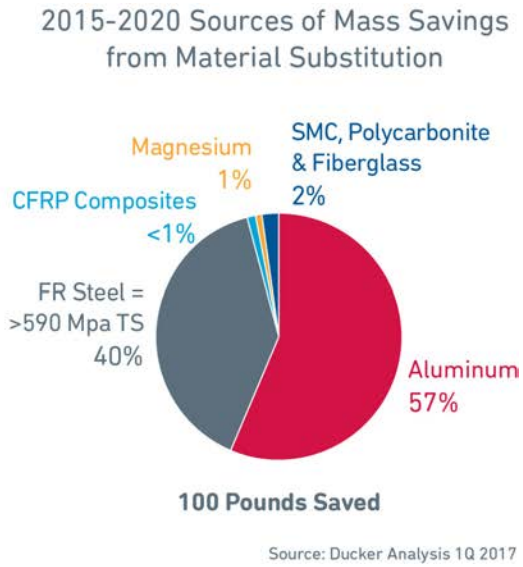
Aluminum material substitutions help OEMs meet regulatory requirements while maintaining design integrity

Aluminum material substitutions for automotive closures have the potential to rekindle the passion for innovative vehicle design. For automotive engineers who remember when design options were less encumbered by regulatory mandates, this is good news. More versatile than other steel-alternative lightweight materials, aluminum serves the needs of multiple masters by providing:

- The strength required to comply with crash-related government standards
- The light weight necessary to meet fuel economy mandates
- The versatility to create the deep, sharp styling geometry designers have become accustomed to, using prohibitively heavier steels







The expanding definition of closures

Automotive OEMs worldwide define "closures" or "hang-on parts" in different ways, but the trend is toward broadening the definition of "closures" to include a wider number of automotive components. In the context of this article, closures are all components not part of the inherent body structure, i.e., those parts welded or bolted on to the underlying structure of the vehicle. These include not only highly style-sensitive components such as doors, trunks, tailgates and hoods, but also a variety of crash management parts like door impact beams and structural parts like roofs.

Perhaps the most striking example of aluminum integration to date has been the Ford Motor Co.'s 2014 release of the F150, in which all body panels, representing 17 percent of its production components, were migrated to aluminum, for a net weight reduction of 676.3 pounds. While not every vehicle will reap the improved efficiency of the production volume of the F150, which is likely to be atypical, this demonstrates the versatility and potential of aluminum substitutions.

Optimizing return on retrofit investments

Any metal material replacement requires a redesign process that takes into consideration not only the differing performance characteristics of the original and substituted metals, but also the compatibility of the substituted metal component with all adjoining metals. When comparing steel alternatives, every potential material substitution is best suited to a particular role. Some are most useful for interior components unexposed to the weather elements, while others are so cost prohibitive that they are practical only in the context of high-end, limited-run vehicles.

MORE VERSATILE THAN OTHER STEEL-ALTERNATIVE LIGHTWEIGHT MATERIALS, ALUMINUM SERVES THE NEEDS OF MULTIPLE MASTERS.

Although aluminum is versatile enough for use in casting applications, and for both exterior and interior components, it is ideally suited to closures. Here, the return on investment in retrofitting metal-sheet-stamping equipment is most rapid. This is due to omission of difficult joining operations like riveting or welding aluminum to steel. A growing number of OEMs are finding it attractive

to widen the scope of their steel-to-aluminum closure substitutions, particularly for more popular vehicle models, because with a higher volume, the cost per unit falls, offsetting the higher initial investment costs compared to non-sheet aluminum applications (e.g. via die casting). No other currently available steel alternative can achieve such significant weight reductions at a better cost.

Achieving compliance, finance and design objectives

The challenge of rethinking automotive designs in the context of aluminum substitutions is being successfully met by automotive OEMs working in collaboration with aluminum processors experienced in optimizing the potential of aluminum. By taking a systems engineering approach to design, aluminum suppliers can identify best-value aluminum solutions and share best practices at every step of the development process, helping compliance administrators, the financial team and designers each realize their specific goals.

In the years ahead, both steel and aluminum manufacturers will continue to work toward achieving ever-better strength-to-weight ratios as they develop materials capable of further extending automotive design possibilities. For the near future, aluminum remains the metal of choice for North American OEMs seeking to meet increasingly stringent requirements around the world.

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