



**Plastic composite structures
in the front end of a vehicle
can lightweight without
compromising safety**

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- When a car crashes, the goal is for the structure to crush in a relatively gradual, predictable way that absorbs much of the impact energy, keeping it away from the occupants in what is termed a “controlled crush.”¹
- Fiber-reinforced polymer composite materials weigh around 50 percent less than steel, though according to a carbon fiber manufacturer, they are characterized by a higher absorption of crush energy per kilogram—100 kJ/kg, compared to steel’s 25 kJ/kg. On impact, carbon fibers can have four to five times higher energy absorption than steel or aluminum.^{2,3}
- Front end components made of these lightweight energy absorbing composite materials are specially designed to fracture in a manner that uses up impact energy.⁴
- An automotive front-end section built from glass-fiber-reinforced polymer composites passed a key 35 mph barrier crash test performed by the Automotive Composites Consortium (ACC), a research partnership established by DaimlerChrysler, Ford, and General Motors.¹
- Passing this type of fixed-barrier test demonstrates that a car is able to absorb its own kinetic energy by deforming its front end without significant intrusion into the passenger compartment, helping protect occupants from the full force of the impact.⁵
- Today, a pressing safety issue is the disparity in design between passenger cars and light trucks. According to Inside Science News, an online publication by the American Institute of Physics, “Redesigning the front ends of light trucks so that they distribute the force of a crash more evenly, and employing technologically available composite materials that absorb more crush energy per kilogram in both kinds of vehicles could reduce the fatalities in such crashes.”



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A composite front end is designed to absorb a great amount of energy upon impact, disintegrating the front end, but helping protect the passenger.

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In front-end collisions, intrusion into the passenger compartment can cause serious injuries. This car did not have a composite front-end.

Additional Information

- An ACC crash test demonstrated that “a fiber-reinforced polymer structure...can perform as well as steel components in crashes.”¹
- “Carbon composite structures can absorb 6-12 times as much energy per kg as steel does.”
-Dr. Amory Lovins, Director, Rocky Mountain Institute⁷
- In a lower to medium-size car, a composite front end could weigh 30% less than a steel front end.⁴
- A critical advantage of lighter vehicles is that they could cause fewer deaths and injuries when there is a two-vehicle crash.⁶
- According to Jason Rowe, chief material engineer for Lotus Engineering, a composite front end will provide the same crash protection in less space than a steel one, which gives developers more room to add pedestrian impact measures.⁴
- “There is no safety trade-off when you replace steel with a correctly designed composite part.”
-John Fillion, an ACC board director and manager of organic materials engineering at DaimlerChrysler in Auburn Hills, Michigan¹

A static crush test of a hollow composite rail element produces the desired controlled crush fracture, absorbing more crush energy per pound than traditional materials.



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Pictures

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- Composite material tube crush: <http://www.memagazine.org/backissues/december96/features/crash/crash.html>

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