

## The Superglue Diet: How to Make a Lighter, Fuel-Sipping Car



**INTRODUCTION:** The 2016 Acadia was listed as having a weight of 4656 lb. The 2017 Acadia is listed by GM as having a weight of 3956 lb.

**QUESTIONS:** (a) What is mass (in slugs) of 2016 and 2017 model of Acadia? (b) What was the % decrease in mass of Acadia 2016 to 2017? (c) What is the linear kinetic energy of each year model at 60 mph?, (d) How much useful work output was performed by each model year engine to reach 60 mph from rest?

**HINTS:** mass = weight/ gravity ,  $g = 32 \text{ ft./s.}^2$  ,  $KE = \frac{1}{2} m v^2$  , 60 mph = 88 ft./s. Work =  $\Delta K + \Delta U$  ,

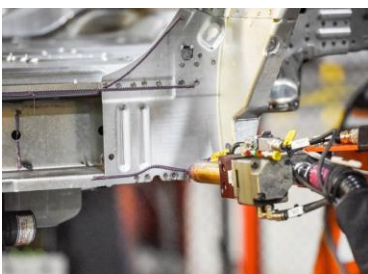
**Robots applied adhesive to bond parts of a GMC Acadia** at General Motors' Spring Hill plant in Tennessee. The glue helps reduce the weight of the vehicle. DETROIT — The 2017 **GMC Acadia** sport utility vehicle that is just starting to arrive in dealerships around the country is **700 pounds lighter than the version it replaces, and can go 23 miles on a gallon of gasoline, up from 18 m.p.g., a 28 percent improvement. One of the secrets to the big weight loss? Glue.** Many of the steel parts of the Acadia's underbody are held together not

by rivets or welds but by advanced adhesives similar to those used in modern airplanes like the Boeing **Dreamliner**. Since this ultra-superglue bonds parts together all along the seam where they connect, not just in certain spots, the parts become stiffer. Because of the stiffness, General Motors is able in many cases to switch to thinner steel, helping the new Acadia shed pounds. The grades of steel are thinner by only about the width of a human hair, but "it's all the little things that add up to the big number," said Charlie Klein, executive director of G.M.'s global carbon-emissions reduction strategy.



**ANSWERS:** (a) 2016 model GM Acadia = 145.5 slugs,  
(b) 2017 model GM Acadia = 123.625 slugs  
(c) % mass reduction 2016 to 2017 = ~ 15%  
(d) 2016 kinetic energy at 60 mph = 563,376 ft. lb,  
2017 kinetic energy at 60 mph = 478,676 ft. lb.  
(e) Work output of 2016 Acadia = 563,376 ft. lb.  
Work output of 2017 Acadia = 478,676 ft. lb.

Parts like a rear door striker latch plate of a GMC Acadia are glued instead of being riveted or welded together.



Glue similar to that used on the Boeing Dreamliner helps the 2017 GMC Acadia check in at 700 pounds lighter than the version it replaced