What is the Cost of a Pound?

Or – How much does it cost to carry, accelerate, and decelerate each extra pound on your vehicle in terms of Energy, maintenance costs, and wear & Tear?

In the world of Energy Efficiency, one needs to look at this another way also – If I want to shed a pound of weight off my vehicle to improve performance, what are the least expensive ways to reduce my vehicles weight first, before I look at more expensive weight reduction processes.

In my own Vehicle – I look at Weight Reduction as a Spiral – If I reduce weight one way – now that I am carrying less weight – what can I do in other areas to also reduce weight since I am not carrying as much weight?

If the Enemy of Acceleration is Mass, and the Enemy of Steady State Driving is Friction and Drag, all of these elements then come into play in a vehicle operation: Mass, Friction, and Drag.

If I can reduce the weight of the vehicle in one approach by 85 lbs but it costs me $3,500, which means that weigh reduction costs $3,500/85 lbs, or $41.1765 or about $41.18 per lbs of weight reduced. If another option can reduce the weight by $108.8 Kg (239.36 lbs), but costs just $1,664, that means it cost just $1,6640/239.36 or just $6.9518 or about $6.95 per lbs of weight reduced. From this it can be seen the option of the second idea is far more valuable, and saves $34.23 per pound of weight reduced over the first option. It looks like a hands down winner, but there is more – what are these two ideas representing?

Option one – is a new AC Motor for my car – which weighs just 85 lbs, versus the current DC Motor which weighs 170 lbs.

Option two – is a replacement battery system for my car, changing from Sealed Lead Acid or AGM Batteries, to new ThunderSky Prismatic 40 Ah Lithium Iron Phosphate Cells. While both could be incorporated, and both can be carried over to another vehicle, the lowest cost factor approach favours the battery upgrade, before the motor upgrade.

There is more to it though – what are the motor differences, and can either of the batteries satisfy its needs? The new Motor, being an AC Motor, offers Regenerative Breaking which the DC Motor in the Car currently does not. The New Motor controller has a peak power load of 550 Amps, which the Lead Acid Battery would have to deliver 10X its rated capacity or 10C – which it is not rated to do, and the ThunderSky Cells have a maximum Continuous rating of 3C – so they could not be expected to deliver more than 40 x 3 or 120 Amps Continuous, but might be able to deliver a few seconds at 800 amps, so we are told. In any case – it appears neither battery would support the new motor. As to the current motor, with the older Lead Acid batteries it has seen a load of a continuous 185 Amps at 75 Volts, with the larger 100 Ah Batteries previously in the car, when they were new. This works out to 185A x 75V = 13,875 Watts. If the ThunderSky Cells can hold voltage at their nominal pack level of 102.4V, this means that the continuous load would be just 135.4980A or about 135.5 Amps. This is still a bit above the maximum continuous rating at 3C of 120 Amps, but could be dealt with by slowing the vehicle down from 100 Kph to 85 Kph.

If that is not an option – then – the question is – will the savings of the above mentioned 239 lbs, reduce the loads enough to maintain 100 Kph at just 120 Amps, or can aerodynamic means be used to reduce the drag, and other means be used to reduce friction (Rolling and Gear Train), to reduce the load by at least 15 Amps at 100 Kph?

Questions to be continued! Keep a Watch out for the next 1-page enquiry! Robert Weekley, February 7, 2012.