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To lithium . . . or not to lithium, that IS the question

Question: I would like to hear Bob's or other folks comments about aviation use of the lithium batteries supplied here:

http://www.lithiumaviationbattery.com

They seem to offer significant weight reduction

Answer: Yes, among other things. Quoting from the website:

> ***If your reading this; you already know that the primitive lead acid battery is going the way of the horse and buggy.***

. . . yeah . . . sort of.

I can tell the List that there are a whole lot of folks intently interested in exploring alternatives to the legacy lead-acid battery technologies for a host of applications, not the least of which are aircraft.

I've been indirectly and directly involved in battery studies for general aviation for over 10 years . . . and I can tell you that none of my former places of employment are looking to go lithium as the standard equipment battery . . . yet.

A variety of new-wave technologies have come and gone. Some have proved useful in specialty applications such as portable power for computers, tools, cameras, phones, etc. Most of these applications did not demand high cranking currents to start engines nor were they expected to work at cold temperatures. The were not intended to be significant reserves of energy to back up engine driven power sources. Further, in small energy demand applications, the extra electronics needed to optimize battery performance was not a big cost of ownership burden. The website offers a table of battery selection data which I have captured in Figure 1.

Table of Batteries Offered

Ah	Wt./lb	CCA	Dims with heat shrink Cover	Price
4.6	1.7	200	4.5 x 2.2 x 3.3	$200
7.0	2.3	300	4.5 x 3.5 x 3.3	$300
9.2	3.0	400	4.5 x 4.8 x 3.3	$400
11.5	3.5	500	4.5 x 6.0 x 3.3	$500
13.8	4.0	600	4.5 x 7.2 x 3.3	$600
16.1	4.5	700	4.5 x 8.4 x 3.3	$700

Figure 1. Battery Selection Table

The table lists capacities, weights, 'cold cranking amps, dimensions and price. The table is offered as a means of selecting a battery size based on engine cranking requirements. The table makes no mention of battery selection criteria based on a load analysis for the endurance mode of operation. Information in the table or elsewhere on the website does not speak to the equivalency of the lithium product compared to lead-acid when it comes to 'cold cranking" capabilities.

The website does not offer data on measured or predicted cranking performance versus temperature. Nor does it offer useful capacity versus loads for calculating endurance for battery-only operations.

Keep in mind that there have been several small "gee-whiz" battery offerings in the past that would crank an engine. A number of years ago Bolder Technologies here in the US was attempting to pioneer a jelly-roll, valve-regulated, lead-acid (VRLA) technology wherein the cell's power connections were attached to the entire edge of a rolled up thin metal film (TMF). The cell's capacity was on the order of 1 ampere-hour. But it's internal resistance was so very low that an array of 6-cells would deliver enough current (for a short time) to crank an engine.

The original company was unable to meet it's marketing

goals and folded. It's descendant products are offered by a company out of Singapore at:

Http://tinyurl.com/3sx5m4s

Wow! An engine cranking battery that weighs just over a pound! The product is being offered in a hand-held, dead-battery solution called the "Secure Start" and can be reviewed at the same website.

Interestingly enough, the Secure Start is shipped with a 'sustaining pack' of alkaline d-cells that are removed and discarded when the Secure Start is unpacked. Hmmm . . . doesn't speak well of long term storage capabilities?

All the latest and greatest battery product like to showcase their ability to get an engine started. Cranking the engine is a concern only for the first few seconds of the day's flight operations. How about the rest of the time?

A minimum lithium battery that would crank your Lycoming might weigh in at 3 pounds and cap check at 9.2 A.H A battery built up of Bolder TMF cells would weigh just over a pound and is probably good for 0.7 A.H at a 5A rate. How long would either of these batteries run your e-bus?

Okay, assume you've got Z13/8 and endurance loads are not an issue. How many 15-pound, 18 A.H VRLA batteries can you buy for the lithium price of $400? Let's say 5 batteries. In a situation where the e-bus is supported by a second alternator, then you might get 2-3 years service life out of an VRLA.

2 years x 5 batteries gives you 10 years at a cost of ownership for 5 batteries equal to that of 1 Lithium battery. The lithium battery has warranty of 5 years and is a somewhat unknown player in the market competing with an suite of VRLA products offering a target service life of 10 years.

Okay, The lithium battery is 15 pounds lighter than the 18 A.H VRLA. That's 2.5 more gallons of fuel. Are you going to fit your airplane with larger tanks? Probably not. So no help on fuel. How often do you leave 15 pounds of baggage behind because you're that much over gross? Hmmm . . . at 10 gph you'll be back under gross limits in 15 minutes after takeoff . . . doesn't seem like much of a worry there either.

So what is the expected return on investment for a $20 per pound of weight savings?

Suppose you don't have the second alternator and you really want 12+ A.H of endurance bus support for alternator-out ops. Now we're talking about a $600-$700 battery. That will buy a LOT of VRLA capability.

How about service life? At least with the VRLA, you're starting with a clean slate every two years. If you accidently trash the battery for lack of good preventative maintenance, a replacement VRLA is at most a few miles /hours distant for $80 or less. The gee-whiz lithium is an overnight Fed-X run for $400-700.

The point is that until one has considered ALL the design goals that drive battery selection, getting sucked down the whirlpool of lighter, stronger, sexier, etc. etc. may encourage decisions that abandon technologies with proven performance, no surprises and attractive cost of ownership.

If you're selecting a battery for Voyager, it takes about 5 pounds of fuel to carry 1 pound of airplane around the world. So 15 pounds of battery would translate to 75 pounds of fuel just to carry the extra battery weight. Uncle Burt MIGHT have been interested in the Lithium products even back then. Out at HBC right now, trimming 1 pound out of the empty weight of a biz-jet is worth $2000+ in reduced costs of ownership over the lifetime of the airplane. But there are important things to consider above and beyond weight savings and getting the engine started. That's why at present there are no lithium products going into HBC aircraft as the main battery.

I suspect that once the RV builder has considered issues of weight, endurance-mode support, cost of ownership over the LIFETIME of the airplane, cold weather operations, and accessibility of spares . . . that stodgy old VRLA still has a few things going for it.

Yes, these are experimental airplanes. The owners of Lithium Aviation Batteries are out to show the world a 'better mousetrap' and I do wish them well. If you have (1) the cash, (3) the willingness to assist these folks in developing their market-worthiness, and (3) weight is really your #1 decision driver . . . by all means go lithium. If I were flying an RV, I'd do it to have fun while minimizing cost of ownership, minimize maintenance risks, and meet a spectrum of design goals. Please make sure ALL of your goals are identified, prioritized and considered in your battery selection decisions.

Ten years from now it may well be that everybody will be scoffing at the VRLA hangers-on. I hope that the technology and market positions will have matured sufficiently to make that a reality. But that's not today folks.