

AUGUST 2004

UPCOMING EVENTS

- August 24th Meeting
- See George's Corner for the latest on Hybrids

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Upcoming Events:

Going Transportation Conference September 10, 2004 in Boulder Colorado at the Chautauqua Auditorium. More information available from Graham Hill 303-544-0025 or ghill@21wheels.com.

The next Electrathon Race will be on October 9th in Fort Collins.

Look for pictures of Brent Singleton's electric powered junior dragster at Bandimere Speedway in the Western Conference Finals in next months DEVC newsletter.

The Family Fair-Innovation for our Energy Future at NREL displayed an on the road Toyota Highlander EV fueled by a Fuel Cell. The vehicle was from California and made a silent pass around the parking lot as it was loaded on the truck for the trip home. Lease one of your own for only \$10,000 a month.

DEVC Newsletter

Next Meeting – Light Rail Across America

Tuesday, August 24th at 7:30pm, Transportation Resource Center, 1401 Walnut, Boulder, Colorado

The August meeting will be held in Boulder at the Transportation Resource Center 1401 Walnut (next to Federal Express) from 7:30 until 9:30 pm on Tuesday, August 24th. The speaker will be Bob Brewster, longtime train enthusiast, historian and advocate. The topic will be Light Rail Across America.

DEVC On the Web

From Mike Bachand.

The information on the DEVC website has become a bit stale lately. This has primarily due to my lack of time to keep the information fresh. Members will see updates to the website much more frequently over the next few months. All websites are only as good as the content they contain and the ease with which users can quickly find the information that they are seeking. I need articles and information like your favorite EV related website links so that I can update the DEVC site. Please email me directly with articles suited for either the newsletter or the website that you run across each month.

We need five more members or sponsors to volunteer to take the newsletter in electronic form in the next 30 days. Please help us continue to keep our costs and dues low. Please reconsider converting from paper to PDF. All you need is an email address and a free downloadable version of the Adobe Acrobat Reader to view the DEVC newsletter in color! If you would like to convert simply send your name and email address to Geogless@cs.com indicating that you are willing to receive the newsletter in PDF form.

Next Electrathon/Devra Race

From Bill Williams.

The August Electrathon race sponsored by the DEVC was held at the Front Range Community College Longmont Campus Parking Lot at 2:00 PM on Sunday August 15th. While not as hot as it was for the last race at FRCC it was still clear and sunny for the race. This time there were four cars from Ulysses HS in Kansas led by their advisor, Randy Phillips, with the drivers as follows: Brittany Zirkel, #17; Corey Morris #31; Tara Hampton #97. There was even a new car under development that they had brought just to get other drivers impressions!



There were two Fort Collins cars, the former Hendricksen later Rossmiller #40, still going strong, driven by Brad Tallis and the Fort Collins HS Technology Students car # 3A driven by Mehrdad Zarifka. The Rocky Mountain HS car #14 was still broken from the previous meet and did not attend! Finally there was Ken Jones in his car # 9 and George Gless in his

car #17W to complete the field.

The race started with a parade lap behind Gary Rossmiller on the Dan Hendricksen racing ElectroBike for a flying start. After 10 minutes there were two groups of cars with numbers 3A, 9, 17W and 97 completing eight laps with everyone else at seven. At the 20 minute mark things had shaken out further with Tallis (#40(and Hampton (#97) pulling ahead with 17 laps and the rest two or more laps down. But fate struck near the 30 minute mark when Ken Jones blew a tire coming into the south 180 degree corner and dug in a rim, rolling the car, scuffing up Ken, and stopping the race! The car's day was over due to a bent rim but Ken carried on. The pause seemingly invigorated the other racers as upon restarting speeds picked up appreciably! Tallis and Hampton ended the fourth period with 36 laps each while Morris (#31) had risen to just one lap back. Gless (17W) had lost battery power and parked but every one else continued on.

Things had really changed after another ten minutes. Zarifka (#3A) had lost his batteries and Morris (#31) had overheated his motor and stopped for some ice! They both restarted and limped on for 5th and 4th places respectively leaving Tallis, Hampton and Zirkle to battle it out in the final ten minutes. Sad to say Tallis had his batteries fade at the last leaving him with 54 laps for third place but Zirkle and Hampton continued to end with 60 laps each with Hampton crossing the line first for the win! Very well driven races on all parts.

Some of the lessons to be learned here are: battery management is still an issue, vehicle stability can turn a minor problem into a major one, and heavily loaded motors need thorough cooling systems. And years of experience are hard to beat!

Special thanks to Randy and his crew from Ulysses, KS for joining us in this race. It was a pleasure hosting them. And thanks to Ellen Williams for managing the timing and scoring and to Ken Jones for all of his efforts in arranging the use of the facilities and for all the other things that he did to make things work out! The FRCC was very kind in allowing the use of their facility and Connie Dewart was instrumental in arranging this. We hope that we may make use of it again! Our next race is planned for October the 9th in Fort Collins.

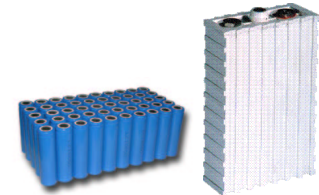
Puny Laptop cells power EVs big time.

From Davide Andrea Boulder CO 7/14/04. (See Table at Right)



EV designers in search for the holy grail of a perfect battery have been exploring Li-Ion cells for some time.

Li-Ion cells have impressive specs, behave nicely, and are environmentally friendly. After solving some safety issues, the remaining obstacles to their use are their high cost, and the need for a Battery Management System to keep them in balance. Today, a few teams are tackling those two issues with a novel approach: massively paralleling the Li-Ion cells used in laptops. They believe that the consistency and the ever-decreasing cost and of such cells justifies the effort required in managing a pack with 1000's of cells. This article describes the work of 3 such teams.



46 ea. 18650 1 ea. TS-LP8581A

Price	92	115\$
Capacity	101	100Ah
Peak charge	1	0.3C
Peak discharge	2	2C
Mass	2.0	3.0Kg
Volume	0.8	1.95liter
Energy	364	360Wh
Power	729	720W
Energy density, volumetric	466	185Wh/l
Energy density, gravimetric	167	120Wh/kg
Power density, volumetric	958	369W/l
Power density, gravimetric	360	240W/kg
Price / energy	0.25	0.32\$/Wh
Price / power	0.13	0.16\$/W
Price / capacity	0.91	1.15\$/Ah

Commonly known as the 18650 (meaning 18 diameter by 65 mm long), this Li-Ion cell has become the standard in many laptop battery packs. Its specs and safety features have improved significantly over the years, while its price has continuously dropped. Millions are manufactured in the Far East, making them very reliable and very consistent. But you and I can't buy them, as there is a concern that Li-Ion cells in the hands of the untrained users could be dangerous. Only authorized manufacturers of battery packs can buy them.

These cells are not ideal for EV use: paralleling many dozens of 18650 cells is far harder to do than buying a single cell of equivalent capacity; and the 18650s are not optimized for power (which EVs need while accelerating). Yet, some people feel that their reliability offset those disadvantages.

Let's compare the typical 18650 cell with the Thundersky TS-LP8581A (a 100 Ah cell that is commonly used in EVs) - [http://www.thunder-sky.com/LP8581A\(EN\).htm](http://www.thunder-sky.com/LP8581A(EN).htm).

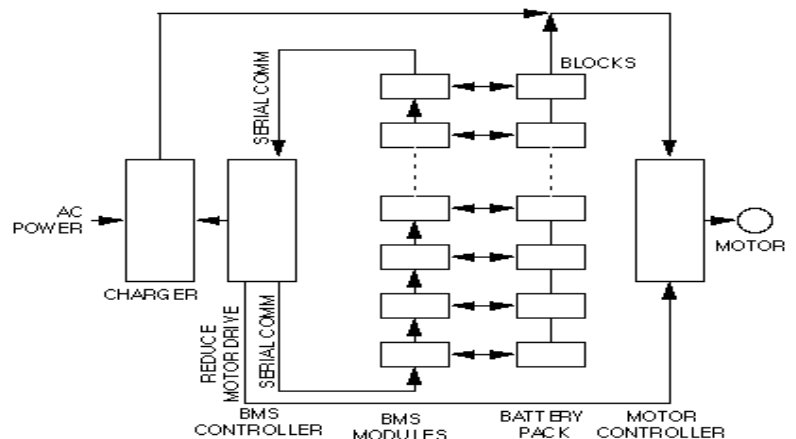
You'll notice that you get about the same bang for the buck for either cell. But the 18650 is much more compact: for example, for a given volume, you get 2-1/2 times more energy and power. A pack using 18650s cells will be lighter and smaller than one using Thundersky cells.

It appears that the first team to explore using 18650s in an EV was Alan Cocconi's AC Propulsion. http://www.acpropulsion.com/EAASV_101803.pdf. They replaced the VRLA batteries in their T-Zero with 6,800 18650 cells, and got a range of 300 miles! They believe that consistency between 18650 cells is so high that a BMS is not necessary to keep them balanced. Like most people, this team doesn't trust pressure contacts, preferring instead to weld the cells together. They sacrifice labor and serviceability for the sake of reliability.

Another team consists of 2 EV gurus: Otmar Ebenhoech, the genius behind the 'Zilla (*The controller for EVs*), and Bob Schneeveis, a mechanical wizard and creator of imaginative robots (both of Palo Alto). Otmar is working on a BMS system using a BMS module per cell (using inexpensive PIC processors). He believes that the module doesn't need to dissipate much power, because the 18650 cells are so consistent, so that it doesn't take much to balance them. Bob has done tons of research on 18650 cells; he has developed a battery compartment that holds 18650 cells, without welding, capable of maintaining contact through vibration and oxidation. He is willing to share his solution with the EV community. This team is developing the 18650 system for Bob's Sparrow.

A 3rd team consists of Ed Thorpe and Edward Ang (in the Bay Area) and Davide Andrea (a DEVC member, in Boulder, CO). They are developing a BMS system uncannily similar to Otmar's. They developed a weld-less battery compartment, but abandoned that design in favor of Bob Schneeveis' superior design. They plan to start with a 24 V scooter, then move to a Sparrow. This project is open source: you can read their progress at <http://www.evtech.org/phpwiki/index.php/18650LiIonBMS>

Each of these people has a different primary reason for using 18650's. To the best of my understanding, Alan Cocconi wants to be at the forefront of EV design; Otmar wants



to make EVs more practical, so that he can sell more controllers; while Bob, Ed, Ed & Davide like the technical challenge and want to help the EV community. Yet, all 3 teams share the belief that piggybacking onto the computer industry's optimization of the 18650 cell will greatly benefit the EV world.

George's Corner

HONDA HAS ANNOUNCED THAT A HYBRID ACCORD is going on sale later this year. Not many details yet but it will have a V6 with Honda's IMA (Integrated Motor Assist) system which is a motor/generator built into the flywheel as used in the Civic Hybrid and the Insight. The engine will run on three cylinders during cruising and deceleration and shut down when the vehicle is stopped. Fuel efficiency is said to be that of a four cylinder Civic sedan and performance better than that of the current 240 horsepower Accord V6. From page 6 of the EEVC Newsletter for July 2004.

THE INSTITUTE FOR LIFECYCLE ENVIRONMENTAL ASSESSMENT recently made a study of the possibility of a hydrogen economy. Its report makes a case for the battery EV based on better batteries such as the Li-ion and the assertion that a fuel cell powered vehicle using hydrogen produced using electrolysis uses about four times as much electricity per mile as does an EV. If you consider a plug-in hybrid which has enough battery capacity to make most short trips on battery alone, it would make good use of electricity from alternative sources and would certainly serve to stretch our oil supplies. (Editor's comment, assuming a clean source of hydrogen) If the IC engine of the plug-in hybrid were fueled with hydrogen, it would be a clean system and make good use of the electrical source. From page 7 of the EEVC Newsletter for July 2004. If you would like to see the whole report, go to <www.ilea.org/downloads/Mazza-hammerschlag.pdf> which yields a PDF file to download.

A DREAM ABOUT TO COME TRUE? A lead-acid battery that is light weight, doesn't suffer too much from grid corrosion, has a long cycle life and resists sulphation. Firefly energy, a company which has taken form in the materials R&D wing of the Caterpillar Company in Peoria, Illinois, has developed a prototype which possesses such properties, at least in tests conducted to date.

Light weight is achieved by using a conduction foam filled with lead oxide. Corrosion is inhibited by coating the foam with a very thin conducting layer which contains the additions needed to make a lead acid cell function in a useful manner. The completed plate is said to look much like a piece of toast. Apparently the tendency for sulphation to form is retarded by the foam construction. The author was constrained as to how much detail he could disclose but he did mention that foams were used in other cells such as NiCads.

If tests prove that the new idea will work, who will build it? Battery industry people like ideas which will work on their machinery so they may not go with it. However, with performance approaching that of NiMH at a great deal lower cost, the hybrid car builders may just get into the act. Anyway, idea man Kurt Kelley, senior vice president Mil Ovan (materials) and CEO Edward Williams feel that they are onto something. Incidentally, none of them are from the battery industry. Batteries + Energy Storage & Technology, Summer 2004, pages 61, 63 & 64.

WHY A HONDA INSIGHT HYBRID WITH A LEAD-ACID BATTERY in place of the normal NiMH unit. The NiMH is a great battery but it is expensive and adds to the cost of a hybrid. If a lead-acid battery could replace the higher cost unit, it would be a boon to both the lead battery industry and the auto builder. To try out the idea, the Honda Insight of Allan Cooper and his wife became the object of a project to install and test the idea.

One of the toughest and most time consuming parts of the project was reverse engineering the Honda system to determine the operating regime of the battery. The work was done at the Rholab with help from the ALABC, the UK government and the Universities of Warwick & Sheffield.

Basically the task involved replacing the NiMH assembly with an L-A setup which would function with the Honda system. The final design consisted of 4-36v modules. Each module consisted of 18, 2v-8 Ah dual tab Ceylon cells developed by Hawker Battery from standard Ceylon cells which owe a lot to the Gates Energy design developed by John Devitt and his colleagues. Mounting and wiring problems were simplified by placing the cells between PC boards which made the needed cell connections and handled the battery management system connections as well.

Anyone who has lived with a series string of L-A cells for very long knows that some will get low on soc and equalizing charge is necessary but this means the good cells will be over charged. In addition, a cell may fail and compromise the whole string. Here is where electronics comes to the rescue. A battery management system can monitor individual cells and keep all cells reasonably close to the same soc. It can also bypass an individual cell which is failing. Mike Kelloway was responsible for the complex software required to raise the reliability level of an L-A system to that required in the operation of a hybrid vehicle.

At present a group of professional drivers is putting the Insight through its 50,000 mile test run at Millbrook track near Bedford, England. From pages 1111, 1113, 1115 & 1117 of Batteries + Energy Storage Technology for Summer 2004. For more about the ALABC-Rholab program go to <ilzro.org> or Pat Moseley at <pmosley@ilzro.org>.

A FULL PAGE AD FOR AN ELECTRIC BICYCLE? The ad for the TidalForce iO bike appeared on page 137 of Popular Science for September 2004. It has a hub motor in the rear wheel and a NiMH battery in the front wheel. A variable speed throttle on the handlebar allows the driver to add as little or much power as desired. For more information visit <TIDALFORCE.COM> or call 888-880-1988.

DEVC Classifieds

*If you would like to buy, sell, or trade vehicles, parts, or supplies, please contact the Newsletter Editor at devc@devc.org.
posted here for one month unless instructed otherwise. Printed newsletter ads are a service for DEVC members, but everyone is encouraged to post ads in
our Classifieds section at <http://www.devc.org>.*

EV Project Car

Free to good home. Custom built electric car. Uses Honda running gear, but chassis and body were hand made. Battery tunnel thru center of vehicle. Needs electric motor and batteries, plus TLC. Putting this car back on the road would be very educational. A picture of this vehicle is available on DEVC web site. Contact Graham at ghill@21wheels.com. The car can be viewed at Carl's house in Boulder.

About The Denver Electric Vehicle Council

2940 13th Street, Boulder, CO 80304

The DEVC is a 501(c)(3) non-profit educational corporation. Its goal is to offer 1) a forum for information exchange about electric vehicle concepts, designs, and developments; 2) instructive information and opinion to interested individuals and the public and 3) assistance in promotion of the development and use of EVs in the Denver area.

Services are: 1) to arrange talks and tours by universities, companies, and individuals who are involved with EVs or components and 2) to provide information about EVs through a monthly newsletter, current EV literature, lectures and panel or group discussions at DEVC and other meetings, and, through the news media, shows and rallies to the public.

Become a Member

We have members all over the world and about 150 active members. If you'd like to join the DEVC, contact one of our officers or complete the application form located at <http://www.devc.org/membership.htm>.

Anyone may join. Sponsors pay \$30 per year and besides receiving the newsletter, they are listed in the newsletter and may distribute brochures in it. Regular members pay \$15 per year for the electronic version of the newsletter delivered in via email as a PDF. Members that prefer a paper copy delivered via the US Mail pay \$25 per year. Membership data is on the mailing label. For example, 12/1/2003 means that your membership is paid through December of 2003. The DEVC mails about 200 newsletters each month. Other interested persons, companies, and community leaders are included in the mailing list on a temporary basis.

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Alternative Autos

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<http://DavideAndrea.com/>

Baird, Spencer L.

EV Enthusiast
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Canada

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and Motorcycles*
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EnergySense

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Fort Collins Utilities

Municipal Electric Utility
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<http://www.fcgov.com/utilities/>

Free Power Systems

Solar Powered Garden Tools
Longmont, CO 80502
(303)651-3184
<http://www.freepowersys.com>

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Hensley Battery & Electric

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Kielian, Deborah

Political Activist
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Boulder, CO 80303
(303) 499-1088

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New York, NY 10128-1707
(212) 534-6757

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