ELECTRIC AUTO ASSOCIATION

CURRENT EVENTS

Promoting the use of electric vehicles since 1967

December '96 Vol. 28 No. 12

Two Times 'Round The Globe On An Island

ERIK SANDELL, GOTLAND, SWEDEN

The beautiful island of Gotland lies in the middle of the Baltic Sea, near the Baltic countries, (formerly part of the Soviet Union) and Sweden. Gotland became Swedish about 350 years ago. The Scandinavian countries,(Denmark, Norway, Sweden, and parts of Finland) have a language close to each other, so we understand each other well.

My Micra Electric is used on a daily basis as a second family car and I average 400-500 km driving every week and with a total of 80,000 km with the same battery pack.

My family lives on a farm on the east side of Gotland and my wife has a shop on the farm and produces patterns for textile and paper printing. She uses our fossil-fueled Volvo in her business-travels. I use my Micra EV to travel across the island and commute to my work at Visby Airport which is a 40 km trip one way. I work with airport technology and environmental problems. The airport offers free parking adjacent to the terminal building and EV-charging capabilities for visitors who drive these exceptional machines. I count my Micra in that group.

Why use an EV?

Gotland is a friendly land for electric vehicles. The highest mountain rises to 64 m (210 feet) above the Baltic sea. The traffic is very calm and the island's year-round inhabitants number 56,000, except during two summer months. The island is 170 km long and 35 km wide, so if you live in the middle, you can manage perhaps 95% of all transportation needs with an EV.

Gasoline is expensive in Sweden — approximately $1.00 per/liter ($3.79 per gallon) — and, as our then second car began getting old in 1990, it was time to look for alternatives. After many nights at the kitchen table, with calculator, motor diagrams, and battery curves, I'd say to myself, "This will work!" With lower costs and more fun, I have found that my electric vehicle has surpassed all of its expectations. What a feeling —first time out from the garage, softly and silently.

What is a Micra electric?

The Micra electric vehicle is not a cafe racer, it's a marathon runner. The choice of car was an accident. During the summer of 1990 , two Nissan Micras collided front to back.When the two cars were combined into one, only one part, a rear-view mirror, was missing.

In 1991 when the car was first built, two motors were connected at the gearbox. This was not an ideal construction. Now it's better — one small motor which is hot when batteries are empty (what I mean is, if you want to build an effective drive-train, battery, controller, motor, gearbox, etc., all the parts need to fit together. If you have a large motor, and a controller that can handle it, and you can empty your batteries without heating the motor, you probably carry around a overweight motor, or at least you have built a cafe racer).

Air-conditioning is not needed on Gotland. It often snows 2-3 months out of the year, so heating is more useful. The electric motor is cooled by a separate fan and a return chamber which supplies the airstream for de-icing the system. It is sufficient for defrosting the windows but not warming the driver, I need the seat-heater at maximum-power during wintertime.

When I converted the EV, it became a two-seater; chauffeur and a passenger. Another passenger can sit on the battery-box as a back seat! Sweden has weight regulations on electric vehicles as it does on as ICE vehicles.

Up to now, the Micra EV has done > 80,000 km, at 2175 charging cycles using the same battery pack. This works out to be about 3720 km/charging.

It uses a gearbox, but no clutch. Normally I drive in second and third gear; second when starting and in town; third at road speeds of 50 - 85 km/h. When wind is at my back or when I try to impress, I use fourth and fifth.

continued on page 4

IN THIS ISSUE

HAPPY HOLLY-DAYS!

PHOTO CREDIT- PAGE 1

Spyder Juice waiting to start autocross in front of FSEC's new building.

CE STAFF

Managing Editor
Clare Bell
544 Summit Drive
Santa Cruz, CA 95060
Tele: (408) 469-9185
Fax: (408) 469-3714
E-mail: CE96ed@aol.com

Contributing Authors
Eric Sandell
Jim Piper
EAA Phoenix
Bill Young

News In Brief
Ruth Shipley

Calendar of Events
Kathy Watson
Lanette Racine

Photography Credits
Eric Sandell
Bill Young

Advertising/Design/Printing
Susan A. Hollis (PCtek)
Email: PCtek@ix.netcom.com
Fax: (408) 374-8787
18297 Baylor Avenue
Saratoga, CA 95070

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EAA Membership
2710 St. Giles Lane
Mountain View, CA 94040

Editorial

BY CLARE BELL

Good Job, Phoenix!

CE has often spoken of opening up its pages to EAA chapters to print or reprint material from their newsletters. This time, EAA Phoenix has taken us up on the offer. In addition, the technical report comes at a timely moment — EVTC has just announced the 1997 Phoenix Electrics. The central focus of that event is the High-school Stock Class. If they haven't already begun on their entries, high-school teams will soon be scrambling to build cars. This report is intended to help them build the best and safest EVs possible.

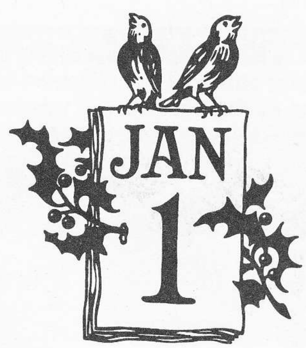
When Phoenix submitted this article series, Jim Piper suggested it be published as soon as possible, to give the most benefit. We're taking his suggestion by putting the first two portions of the report in this issue, namely the discussion of powertrains and chassis selection. These are the most important ones and the first to consider when starting an EV project. They are also most relevant to anyone considering a street EV for commuting. "Selecting a Charger" will follow in January and "EV Climate Control" in February.

EAA plans to send 50 or 100 copies of this December issue to Phoenix for distribution to high school teams. By working together, EAA National and Phoenix Chapter can help the people who will have the most influence over the future of EVs, the young EV enthusiasts on the High School Stock teams. This is valuable stuff! Thanks, Phoenix!

Special thanks to Lanette Racine, Phoenix chapter newsletter Editor and Webmistress. She and Kathy Watson do the Phoenix EAA Website, perhaps the best one in EAA. Check it out.

What's ahead for CE in 1997?

First, we are going to improve mailing times. Now that production is pretty much on-schedule, delays are due to glitches in the labeling and mailing process. This was being well-handled by Bruce Brooks, but since he has had to focus on other things, his absence has created some temporary problems, which should be resolved with this issue.



Having sustained a monthly issue of 24 pages, with pretty much on-time performance, CE is going to take another step by going into digital pre-press. We have already experimented with printing digital images, but have had some problems with resolution due to our regular pre-press process. Going digital will increase the quality of electronic images, making them clearer and crisper. Hopefully this issue will be the first produced under the new process. I look forward to the results.

1997 will probably see the first CE color cover too! —CB

Dream Team Wins Challenge

ADELAIDE, Australia, Oct. 30, 1996 - Even a wrong turn on the last leg of the route couldn't take the Australian Solar Challenge race away from the Honda "Dream". Overcoming his chagrin at turning into oncoming traffic, the Dream's driver quickly recovered. He brought the sun-powered $7.9 M Japanese entry through hordes of Aussie automobiles to a safe and triumphant finish, winning the 1996 Australian Solar Challenge.

Despite the unplanned excursion, Dream became the first to complete the 3,010 km (1,870 mile Challenge route from Darwin to Adelaide in just four days. According to race officials, the Honda solar car took 33 hours, 32 minutes, averaging 89.76 kmph (55.77 mph). This shaved two hours off the previous record held by the 1993 Honda Team of 35 hours and 47 minutes at an average of 84.96 kmph (52.79 mph).

Despite the hot and humid desert drive past the famous Uluru (Ayers Rock) the four-member Dream team had no real problems, mechanical or physical, according to Honda team leader Masashi Kitagawa. During a post-race news conference, he said he was pleased with the car's performance.

Race organizer Hans Tholstrup, who is retiring from the event he founded in 1987, feels that suburban roads will never be dominated by solar-powered vehicles, but the Challenge race will lead to improvements in the efficiency of passenger cars..

Source:Reuter (webmaster@reuters.com) Fax# 415-3986593, Tel# 415-677-2544. 153 Kerny St., Suite 301, SF, CA 94108 USA Attn: Mark Thayer. Web adress, http://www.reuters.com/

POSTed by Bruce Parmenter on the Electric Vehicle List News. For Public AE & EV informational purposes.

Two Times

continued from front page

Batteries

The batteries have worked much better than expected. One problem, though, is keeping them at a good steady temperature throughout the pack, especially in the winter. Tubular cells have higher internal resistance than most flat-plate batteries, which helps. One discharge causes an increase of about +3 degrees Celsius in the battery pack. The maximum average driving distance at this time with the old batteries is about 50 km at 70 km/h. When they were new, the car went nearly double that distance.

The batteries are serviced every 1500 km. Service takes approximately 30 minutes and consists of charging at low current < 3A, and measuring all block voltages. Then if all 6-volt batteries are fully charged, I don't adjust the charger. Adjustment is needed depending on the number of charges and temperature. I add water when needed, about 4-7 liters for the tubular cells. I use the cleanest water I can get from a laboratory.

When the 1000th charging cycle arrived, I compared readings on different batteries. Some boiled at a cell voltage of just over 2.35V while others on the same charge circuit passed 2.8 v/cell before gassing. On the EV-battery block that was most easily charged, I installed a voltage-limiter. This limited the battery block to at 7.5-7.8V per batttery at the end of charge. At 1500 charging cycles, all blocks were charged to the same level and the limiter was removed.

Charging

The charging equipment is home-built. It is controlled by at least 3 down-steps in current at different voltage limits. These limits are chosen at service, then you don't need to think about when to charge, you do it at every opportunity; in other words, very nearly 21 hours per day.

GVEA stands for Gotlands Vinner av Elektriska Automobiler. Translated, it means "Gotland's Friends of Electrical Automobiles"

We have a small club, about 30 members. We meet every month and discuss EVs. During 1993 and 1995, we used these meetings to study EV calculations and building. As I write this article, we have 5 EVs on Gotland Island, which gives a ratio of 1 EV per 11,000 people. A record in Sweden, but not too honorable.

Our small but enthusiastic club spreads knowledge about electric vehicles and provides information about EVs and charging sites on Gotland. One project during 1997 is an "EV-map" of Gotland, which shows charging sites and other services in the surrounding areas. —ES

Erik Sandell <aura.gotland@mn.medstroms.se>Aurungs Norrlanda S - 620 23 Romakloster Sweden

Originally published in the Phoenix Chapter Electric Auto Association's August's newsletter. From evchdlr@primenet.com Tue Sep 17 16:12:56 1996

Thanks goes to Erik Sandell for submitting his very interesting article.He was somewhat concerned about his English. Great job! Lanette Racine, Editor — Phoenix Chapter EAA

CARB Responds to Carnegie Mellon

Sacramento, Calif. - The California Air Resources Board (CARB) is charging a Carnegie Mellon University professor with continuing to spread misinformation about electric vehicles (EVs) and with ignoring errors in his recent study

CARB charges that in an article by Lester B. Lave published in September in Environmental Science and Technology, "there appears to be a systematic bias in the methodology to overestimate lead emissions from (lead-acid battery-powered) EVs and underestimate lead emissions from conventional vehicles." Among examples cited: lead-smelting emissions are overstated, battery recycling rates are underestimated, emissions reductions from EVs are understated by a factor of five, and he assumes EVs in 2010 will use lead-acid batteries, even though no major automaker is planning to use them in the long term.

Source: CALSTART NewsNotes 10/31/96. Thanks to ddevlin@loop.com

Editor's Note:

Anyone who would like an electronic copy of the Carnegie Mellon paper that appeared in Environmental Science and Technology, please send a request to CB at ce96ed@aol.com.

It has been hard to find. I had to type this one in from fax hardcopy.

If you are interested in contributing to a formal rebuttal to the paper, I am coordinating a group of people who are writing responses. They will be compiled in a press release and sent to the media.

I would like to see Lave and Co. thoroughly discredited and made to publicly retract their statements. They have done a lot of damage which needs to be corrected.—CB

HYBRIDS

New Rosen Motors Powertrain

BY CLARE BELL

Rosen Motors recently announced a hybrid electric powertrain that simultaneously delivers high acceleration, high fuel economy, and nearly zero emissions.The system consists of a turbogenerator, a flywheel motor-generator, an electric drive motor, and an electronic control system.

Turbogenerator

In the Rosen design, a gas turbine powers an electric generator. This turbogenerator satisfies the relatively low average power demands of the vehicle. It burns unleaded gasoline in a catalytic combustor, which, the company claims, produces virtually no pollutants. The turbogenerator comes from Capstone Turbines, who also build units for stationary power systems. In the current Rosen Motors experimental vehicle, the turbogenerator delivers 24 kilowatts at 30 % thermal efficiency. Future Rosen Motors powertrains will use a 45 kilowatt unit.

The generator's rotor, the turbine compressor wheel, the turbine vanes, and the shaft rotate as a single unit, supported by self-pumping air bearings. No liquid coolant is needed, since inlet airflow provides plenty of cooling. The turbogenerator requires no lubrication and only scheduled air filter changes.

Flywheel

The flywheel supplies surge power as well as storing recovered power from regenerative braking. At its maximum charge, the flywheel can store one kilowatt-hour. 80 percent of that is available over the flywheel's operating range of 28,000 - 62,000 RPM. (The flywheel's quiescent speed — not braking or accelerating — is about 55,000 RPM.) The flywheel motor-generator can deliver or accept power at a maximum rate of 120 kilowatts.

Its rotating assembly consists of a carbon filament-wound composite cylinder and ring, a titanium hub and a steel shaft. The rotor of the flywheel's motor-generator and the rotating elements of the flywheel magnetic bearing assemblies are mounted on the shaft and supported by the magnetic bearings.

Only the electric traction motor connects directly to the vehicle's drivetrain. All other components feed it via the electronic controller. Unlike many other hybrid concepts, the Rosen design is not simply a "range extender" for a chemical battery-powered vehicle. Rather, the electronic controller dynamically selects the blend of flywheel- and turbine-generated power for optimum vehicle performance throughout the driving cycle.—CB

Access: Rosen Motors, (415)988-9207 or (818)704-0070 x155 e-mail: deborah@rosenmotors.com

EV Financing

BY EVs NORTHWEST

Several years ago, EVs Northwest in Seattle, WA set up an EV conversion loan program with a large local credit union. The credit union lends 60% of the total "value", arrived at as follows:

- Blue book value (as ICE) of the vehicle to be converted
- Cost of components - $4/7,000
- Cost of conversion (design, labor, warranty) - about $5,000

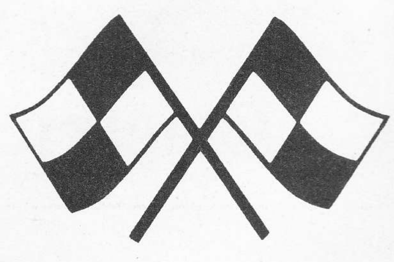
So far, the lender has not seemed overly concerned about actual purchase price of a particular used conversion nor estimated re-sale price of the conversion to be done - thus an individual may very well be able to borrow an amount that significantly exceeds 60% of what he or she actually paid.

Information from EVDL post, Thurs., 19 Sept. 1996 04:33:13. by Skarecrow <evsnw@SEA-MAC.WA.COM>EVsNW, Seattle WA. Website at www.halcyon.com/evsnw

EV LITE

1st Speeder was Electric Taxi

Did you know that the first speeding ticket issued in the United States was given to the driver of an electric taxicab?! It was in New York City on May 20, 1899, that Jacob German was stopped by officer Raymond Schuessler for going 12 mph on Lexington Avenue in his taxi EV. History does not record whether the arresting officer was on foot, on horseback or in a pursuing EV, but the record does note that German was thrown in jail.



Source: John Bryan <jbryan@MICRON.NET>, Wed, 18 Sept. 1996 18:56:20 -0600

EVs for Phoenix High-School Racers

BY JIM PIPER AND PHOENIX EAA

During the Phoenix EAA's August meeting, we proposed that a technical comittee be created. One proposed project was a series of articles on converting an internal combustion engine (ICE) automobile to electric. This technical report is not designed to be a detailed "how-to" nor a definitive definition of a vast EV technology. Several topics were suggested, including:

- Air conditioning (environmental control)
- Powertrain (batteries to wheels)
- Selecting a chassis to convert
  (I added advanced charger technology)

The most logical order seems to be the following:

- Power train
- Selecting a chassis to convert
- Environmental control
- Advanced charger technology

It was also suggested that these articles appear as soon as possible to aid the high schools in preparation for the March races.

Power train technology is rapidly changing, so it is worth spending a lot of research in this area. Study what is out there and what it costs. You will find one or more break points where there will be a sudden increase in weight per horsepower and/or cost per horsepower. Determine what you can afford. This will determine what size chassis you convert. A review of the technology follows.

Definition

Figure 1 indicates the components of the power train and their relation to each other.

The system consists of the following components:

- Battery
- Power cables
- Motor
- Transmission

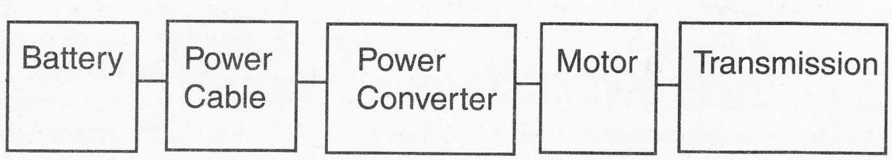


Figure 1 - Power Train Components

Importance of Efficiency

All components are connected in series, so their efficiencies are multiplied to obtain that of the total system. If each component is 90% efficient, total system efficiency is .9 x .9 x .9 x .9 x .9 = .59 or 59%. If the efficiency were the same during regenerative braking, only .59 x .59 = .349 or 34.9% of the energy used to accelerate the vehicle would be returned during braking. With all component efficiencies at 95%, total system efficiency would be 77%. Regenerative braking would return 59.9% of the energy used to accelerate the vehicle.

Most people want to stop at least as quickly as they accelerate. It is wise to select a controller that can generate as much current in regenerative braking mode as it can put out for acceleration.

Losses

Cable losses are equal to the square of the current, or I^2R. The R represents the cable's resistance in ohms. I and A are the symbols used for current. Power is proportional to the current times the voltage, or P=IxV. Most cables can handle up to 600V, which is more than enough for automotive applications. The larger the cable size, for example, 2-ought or 4-ought, the less the cable losses.

Doubling the voltage halves the current for the same power, favoring higher voltages. A good assumption is 1000 VA per horsepower, which assumes nominal battery voltage and that the combined efficiency of cables, controller and motor is 75%.

Figure 2 comes from the Materials Handbook, published by the American Society of Materials. It contains properties of different sizes of copper wire, which should be important to designing an electric car.

Example:
For a 120 volt system, 80 hp requires:
(80 hp x 1000 VA/hp) / 120 V = 667 A

For a 96 volt system 80 hp requires:
(80 hp x 1000 VA/hp) / 96 V = 833 A

Battery losses are current-dependent and also depend on battery chapcapacity and type of chemistry. Nickel-cadmium batteries can generally handle higher current drains than lead acid for the same capacity. In an effort to normalize battery losses, the loss value is usually related to capacity in ampere-hours divided by the number of hours required to discharge that battery. A lead-acid battery is usually measured at the 20-hour rate; nickel-cadmiums are measured at the 10-hour rate. For example, it would take 20 hours at 10 amp to discharge a 200 amp-hour rated lead-acid.

At higher current drain, batteries have less capacity. The same 200 amp-

Characteristics of solid round copper wire: ASTM B1, B3, B258

Conductor size, AWG	Conductor diameter, mils	Conductor area, circular mils	Soft (annealed) wire: Net weight, lb/1000 ft	Soft (annealed) wire: Minimum elongation(a), %	Soft (annealed) wire: Nominal resistance, Ω/1000 ft	Soft (annealed) wire: Nominal breaking strength, lb	Hard drawn wire: Nominal tensile strength, ksi	Hard drawn wire: Nominal resistance, Ω/1000 ft
4/0	460.0	211 600	640.5	35	0.0491	8143	49.0	0.05044
3/0	409.6	167 800	507.8	35	0.06180	6720	51.0	0.06361
2/0	364.8	133 100	402.8	35	0.07791	5519	52.8	0.08019
1.0	324.9	105 600	319.5	35	0.09821	4518	54.5	0.1011
1	289.3	83 690	253.3	30	0.1239	3888	56.1	0.1289
2	257.6	66 360	200.9	30	0.1563	3002	57.6	0.1625
3	229.4	52 620	159.3	30	0.1971	2439	59.0	0.2050
4	204.3	41 740	126.3	30	0.2485	1970	60.1	0.2584
5	181.9	33 090	100.2	30	0.3134	1590	61.2	0.3259
6	162.0	26 240	79.44	30	0.3952	1280	62.1	0.4110
7	144.3	20 820	63.03	30	0.4981	1030	63.1	0.5180
8	128.5	16 510	49.98	30	0.6281	826.1	63.7	0.6532
9	114.4	13 090	39.62	30	0.7923	660.9	64.3	0.8239
10	101.9	10 380	31.43	25	0.9991	529.3	64.9	1.039
11	90.7	8 230	24.9	25	1.26	423	65.4	1.31
12	80.8	6 530	19.8	25	1.59	337	65.7	1.65
13	72.0	5 180	15.7	25	2.00	268	65.9	2.08
14	64.1	4 110	12.4	25	2.52	214	66.2	2.62

Figure 2- ***Characteristics of Copper Conductors.*** *Stranded copper wire has the same resistance and weight of conductor. However, its diameter is larger and its elasticity and elongation is greater. These numbers do not include the insulation.*

hour lead-acid battery provides 110 amps for 1 hour.

Normal battery application data does not include equivalent internal resistance. For most batteries it increases as the battery discharges. A battery's internal resistance may have to be determined experimentally. Measure the open circuit voltage, place a load on the battery, then measure the current and voltage at the battery terminals. Resistance = R = (open circuit voltage - voltage under load)/ current. The unit is ohms. The battery losses are again I^2R. Figure 3 shows typical lead acid battery curves.

Losses through the controller are determined by its design and the type of semiconductors used. Controllers using MOSFETs have I^2R type of losses, while those using IGBTs have I x constant type

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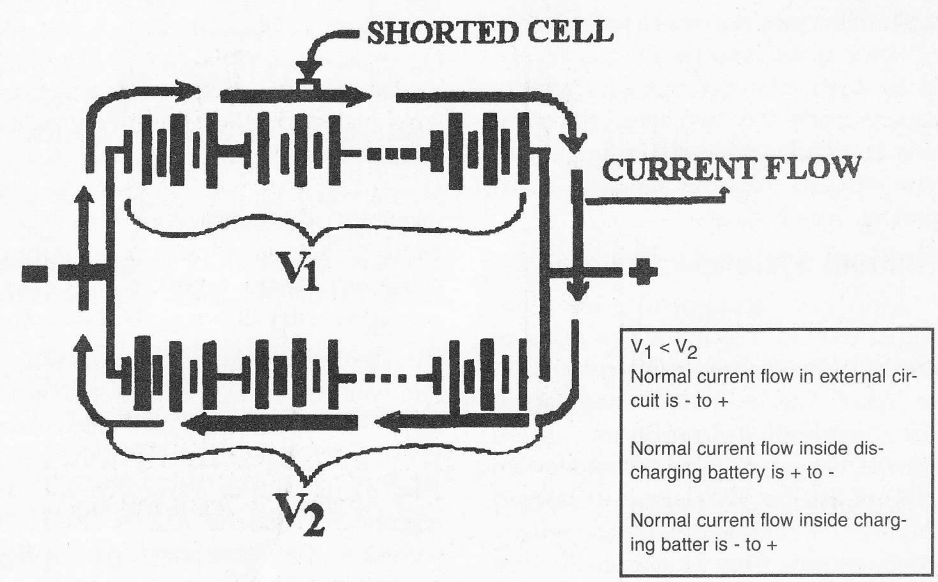

Figure 3 - Electrical circuit of two strings of batteries connected with a shorted cell in one string.

EVs for Phoenix

continued from previous page

of losses. Check with the controller manufacturer for losses at typical cruising (10-20 hp) and acceleration (80% max motor power) points. You may need the losses at maximum power at several motor speeds to understand the losses during acceleration.

Motor losses are determined by type of motor. These will be discussed in a following section.

Transmission

Transmission losses are partially determined by the number of gears in mesh and splashing in oil. They can also vary depending on the viscosity of the fluid used in the transmission. [Cars that change the angle of the drive by using bevel gears (i.e. front-engine rear-wheel drive using a differential) experience an additional 7%-15% loss. - CE Tech Ed. Scott Cornell.] Electric motors have a broad speed range with relatively constant horsepower, unlike an internal combustion engine. Therefore, a lot of speeds in the transmission are not needed. Shunt-wound DC motors and AC motors can be electrically reversed, so that the transmission may not need a reverse gear.

Some manufacturers offer transmissions with their traction motors. These are single or preferably two speed transmissions. Hopefully, these will be lighter and more efficient than the standard transmissions from ICE cars.

Practical Systems

I do not recommend permanent magnet motors. There are two types of permanent magnet materials in common use today. The most recent technology uses Neodymium-Iron-Boron. These magnets have a maximum temperature rating of 200 (to 300 degrees F magnet temperature before they are easily demagnetized. This is especially true under high loads.

With Phoenix ambient temperatures above the asphalt track surface reaching 120 degrees F, or higher, the motor has a large probability of reaching a temperature capable of damaging the magnets during acceleration, braking, and hill climbing. This is because losses in the motor raise its temperature above ambient.

The other magnet material is Samarium-Cobalt, which can stand higher temperatures. It is more expensive and connot generate as stong a magnetic field. Permanent-magnet traction motors typically adapted for automotive conversions probably have been designed for industrial use inside air-conditioned buildings. They probably won't survive automotive demands under Phoenix track conditions.

Permanent magnet designs include Brushless DC and Synchronous AC. These are synonyms for the same device. Some compact brush type motors also use permanent magnets.

DC Motors

There are two types of wound field DC motors; shunt-wound and series-wound. Series-wound motors have the field winding in series with the armature, thus only two connections are required to the motor. Series motors are difficult to use for regenerative braking. A two-terminal motor is also not electrically reversible. The series-wound motor has high starting torque. Usually this is an advantage, but under loss of load such as a broken driveshaft or missed shift, the series motor can reach self-destructive speeds.

The shunt-wound motor has a separate connection for the field and armature. The field winding uses little current to control the speed/power of the motor. This motor works extremely well for regenerative braking and is electrically reversible. One direction is usually preferred.

For a given armature voltage, the shunt-wound motor's speed is controlled by the current in the shunt-winding. Generally there is less than a + 10% change in speed from no-load to full-load. Thus the shunt wound motor is not subject to overspeed conditions unless it suffers a total loss of field.

Loss of field could be caused by a broken wire or failed semiconductor. DO NOT FUSE THE SHUNT WINDING. Instead,use a temperature sensor in the motor to detect a short in the shunt winding. If you must fuse the field, install special indicator fuses that can trip a relay to disconnect the armature if field fuse blows.

Both series- and shunt- wound motors have commutators with brushes. Brushes rely on moisture in the air for lubrication. During part of the year Phoenix humidity may fall low enough to cause accelerated wear. Also, dust can become lodged on the brush surface, scoring the armature and increasing losses. You may want to put a dust filter on the commutator end of the motor. A simple ICE car air filter of the right size can work when pushed over the end of the motor, however the motor may need additional cooling.

Brush type DC motors permit a very simple design for the controller, resulting in a low-cost moderate-maintenance system.

AC Motors

At this time all high speed AC induction motors must be custom-wound. It is advisable to have an engineer look at the bearing design and speed capability of the rotor.

AC induction motors are commonly found at home and in industry, since they can be sealed and totally maintenance-free. The EV1 uses this type of traction motor.

AC induction motors require a complicated controller that can provide three-phase electrical power, which makes them at least 3X as complicated as a DC controller. AC controllers are not readily available, however, many industrial drives use them. Newer designs even have a constant voltage DC buss. Again, however, they are designed for air-conditioned environments.

For you racers, Ingersol has the following motors, used for machine tool spindles.

- 10,000 rpm 60 hp cont. 75 hp intermittant
- 20,000 rpm 50 hp cont.
- 40,000 rpm 40 hp cont.

The two slower motors are permanent-magnet types. Excello has similar induction type motors.

Paralleling Motors

Some people have recommended paralleling traction motors to obtain the proper horsepower, but I do not recommend this.

When paralleling motors, one has to consider the weight and losses associated coupling the two motors to a single drive. One also has to match the brush type of DC motors for the load to be shared equally. AC motors require a common master controller.

Batteries

When paralleling strings of batteries one has to consider what happens if a cell in one string is shorted. To do this, take the cell voltage and divide it by sum of the resistances of the battery strings. This will give you the current caused by a shorted cell when two strings are connected in parallel.

When two strings are in parallel and one has a shorted cell, the current actually flows in series, from the good string to the bad string.

Example:
The Optima battery can deliver 800 amps at 8 volts, with an open-circuit voltage of 13 V. Battery resistance = (13 - 8)/800 = .00625 ohms. For a 10-battery string providing a voltage of 120, the battery resistance is 10 x .00625 = .0625. Assume that the interconnecting cables are half that resistance. Then 0625 + .0312 =.0937. Now double this value (because you are connecting two strings together) and the current flows through both strings in series (see figure 4.) Current due to a shorted cell is 2 volts/.1875 ohms = 10.7 amps.

[One way to watch for trouble in parallel strings is to use a separate ammeter for each string. That way, you can see problems developing. The ammeters don't have to be that accurate, since they only have to detect a difference in current flow between strings. For a shunt the meters can use the jumpers between the batteries, if they have about the same size and resistance — CE Tech Ed. Scott Cornell]

Voltage Effects

Voltage effects were introduced under the section on cable losses. Since Power=IxV, using a higher voltage reduces the required current for a given power output. It also increases the number of battery connections. Each connection has a finite probability of failure; therefore the more connections per pack, the greater chance of a connection failure

Semiconductor technologies have discrete voltage limits. As voltages rise, the selection of semiconductors is reduced and the cost increases. The minimum voltage drop may also increase. High currents cause similar problems. Each circuit design will have optimum voltages and currents depending on the design and semiconductors used.

This is why controllers have maximum voltage and current limits. It is also why there are sudden changes in cost per horsepower in a given controller family.

Battery Technology

There are two types of lead acid batteries; valve-regulated (VRLA) and flooded-plate. The flooded-plate type requires periodic additions of water. These are more forgiving. If they overheat or overcharge and lose water, just add more.

The VRLA is not so easy. The water inside is all you get; you can't add any to these sealed batteries. It is impossible to prevent some water loss. Eventually the battery dries out. This battery type requires a high-tech charger that monitors voltage and shuts off the current at the full-charge voltage (approximately 2.2 V per cell; check with the manufacturer as the exact value varies with acid concentration.). The VRLA is obviously more resistant to spilling in a vehicle rollover. Under impact, both types are subject to rupture.

Conclusion

Now you know what to look for when selecting components for your electric vehicle. Explore the catalogues, ask questions and determine what you want or can afford. —BP

Florida Sun Energizes SunDay Challenge

By Bill Young, Florida Solar Energy Center

Once again, solar/electric powered and alternative fueled vehicles rallied in Central Florida for the Fifth Annual SunDay Challenge.

Twenty-one vehicles from across the country participated in the four-day event. There were solar, electric, hydrogen, and fuel-cell powered vehicles in attendance, including a 1918 Milburn (electric) owned and driven by Ted Holden of Palm Beach Gardens, Florida. A hydrogen/CNG vehicle, the "HY-TEST Pickup" owned by NASA/EG&G of Florida, demonstrated one of the fuels of the future for internal combustion engines. The " EP-Gator" owned by Energy Partners of West Palm Beach, presented the high tech technology of fuel cells. A vehicle that caught the hearts of young and old was an electric scooter; the "Revi" owned by Recreational Electric Vehicles Int. of Alpharetta, Georgia.

On September 21, the 1996 SunDay Challenge started with technical inspection and an autocross conducted in the parking lot of the Brevard Community College/University of Central Florida-Brevard campus. The Florida Solar Energy Center's new location is on the north side of the campus in Cocoa.

Cars parading into EPCOT Center for awards ceremony.

Vehicles from universities, commercial conversions and privately-made EVs participated in the autocross, administered by the Central Florida Sports Car Club of America. "Spyder Juice", a Production Commuter category car owned by Simpler Solar Systems of Tallahassee, placed first with a time of 54.295 seconds.

The 70 mile SunDay Challenge rally course started on Saturday, at the Florida Solar Energy Center and finished at EPCOT in Walt Disney World near Orlando. A spectator parade and awards ceremony was held at the Innovations exhibit inside EPCOT under the shadow of SpaceShip Earth. The vehicles were on exhibit in EPCOT for three days where thousands of people saw them and talked to their owners.

Among the winners was the "Canary II ZEV", in the Tour de Sol Commuter category. "Canary" was built and is owned by Ed Passerini, of Tuscaloosa, Alabama. "Charged", owned by Lynn Conner, Frank Salzmann, and Roy Jones of Oviedo, won the American Commuter category.

Global Positioning System

To help keep track of the vehicles and automate timing and scoring on the rally, we used a Amateur Radio global position system (GPS). The radio operators using APRS program communications on their VHF radios mapped the location of the vehicles as they drove the course. Also, packet communication transmitted vehicle times at the start and check points to the finish line, thereby automating scoring.

This year, tech inspection used a new radar for checking vehicle speed. It was a new device just recently obtained by the

Solar-powered radar on trailer checks vehicle speed.

Sunday Challenge Results

Category	Place	Car name	Organization	City/State
Production Commmuter				
	1st	Spyder Juice	Simpler Solar Syst	Tallahassee, FL
	2nd	0 Emissions	Orlando Utilities	Orlando, FL
	3rd	Electric Jaguar	William Arnold	Cocoa, FL
		Electric S-10	U. of S.Florida	Tampa, FL
Tour de Sol	1st	Canary II ZEV	Ed Passerini	Tuscaloosa, AL
	2nd	Enviro-1	FSEC	Cocoa, FL
American Commuter	1st	Charged	L Conner	Oviedo, FL
	2nd	Watt's This?	Janet&Tim Madden	Palm Bay FL
	3rd	Clunn Car	Steve Clunn	Fort Pierce, FL
		Electric Knight	U. Cent. FL	Orlando, FL
		Electric Triumph	Rick Michaels	Brandon FL
		The Patterson	Jeff Patterson	Tallahassee, FL
		Electro Wheels	FSEC	Cocoa, FL
		ASET Eliminator	U. Cent. FL	Orlando, FL
Open		HY-TEST Pickup	NASA/EG&G	Kennedy Sp .Cent.,FL
		Milburn	Ted Holden	Palm Beach Gardens, FL
		Sunbuggy	Tom Sines	Okeechobee, FL
		EP Gator	Energy Partners	West Palm Beach, FL
		Revi	Recreational EVs	Alpharetta, GA

Open class was for demonstration only

city of Cocoa; a trailer-mounted solar (photovoltaic)-powered radar system to warn drivers about their speed. Everyone had to drive by it, including spectators.

This high tech showcase, was sponsored by the Florida Solar Energy Center (SEC) and the Florida Energy Office of the Florida Department of Community Affairs.

For more information about the SunDay Challenge '96 Alternative Energy Vehicle Rally, contact Bill Young at the Florida Solar Energy Center, 1679 Clearlake Road, Cocoa, Florida 32922, (407) 638-1443. —BY

Chassis Selection

BY JIM PIPER, PHOENIX EAA

Now that we know the weight and power of our drivetrain, we can select the chassis. First, the chassis must be able to physically hold the powertrain. Second, it must be light enough for decent performance. Third, look at technology advances. A 1996 Neon has better performance, room, handling, and mileage than a 1979 Horizon. The Neon would probably make a better conversion.

Rolling Resistance

A good source of information on automotive design is:

The Automotive Handbook, available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096. It costs about $35.00.

This reference provides relative coefficients of drag for various vehicle shapes. It also indicates how to calculate the various coefficients of rolling resistance from coast-down data.

A simplified summary follows:

Rolling resistance is proportional to vehicle weight. Aerodynamic resistance is proportional to vehicle frontal area times drag coefficient times the square of the velocity or:.

Air drag (lb.) = area (sq. ft.) X Cd X [V (ft./sec)]^2

Total resistance on level ground equals aerodynamic resistance plus rolling resistance. Power is determined by multiplying the resistance by speed

- Newer cars have such features as:
- Retracting brake shoes. This reduces friction of brake pads rubbing on the rotors.
- Higher strength steel for lighter weight.
- Improved wheel bearings. These carry the same load on smaller bearings with lower rolling resistance.
- Low drag coefficient (Cd). Newer cars have been designed with the aid of wind tunnels and computer modeling to reduce the drag coefficient. The drag coefficient of the Impact is 0.19. A typical late 1980s wedge-shaped car has a drag coefficient of 0.3 to 0.4.

Things to Look Out for

If the car fits the ICE engine like a glove, chances are that it is not a good choice for conversion. If the car only holds two people before conversion, it probably does not have sufficient payload rating for conversion. When purchasing a car that has been in an accident, any structural damage to the car should eliminate it from consideration.

Payload to Weight Ratio

In interest of efficiency it is wise to look at the Gross Vehicle Weight Rating (GVWR). This is usually located near the driver's door. Another number is the curb weight. This can be located in reviews in magazines such as Consumer Reports, Motor Trend or Car and Driver. These magazines may also provide drag coefficients and GVWR.

Subtract the curb weight from the GVWR to obtain the payload. The payload has to be at least equal to the weight of the powertrain selected. A measure of vehicle efficiency is to divide the payload by the GVWR. Pickup trucks and vans will excel in this area, however they can be too heavy for the powertrain. The drag coefficient is higher for these vehicles than for most passenger cars.

Estimating Vehicle Weight

Your automobile dealer can be helpful in determining the weight of your electric vehicle. He can provide shipping weights for such items as engine and transmission. Allow 4 lb. per gallon of fuel tank capacity. This assumes a half full fuel tank.

You may be surprised to find that your much smaller electric motor and adapter plate weigh almost as much as the ICE it replaces.

Remember, for safety's sake do not remove any structural bracing. This may include diagonal members under the hood. However, remove any items from the ICE system that are not needed in the EV.

Remaining payload capacity equals curb weight - weight of items removed + weight of drive train, subtracted from the GVWR. Make sure that this is sufficient to meet your requirements. Assume 200 lb. per adult for person, clothing and luggage or shopping trophies. Assume at least 100 lb. per child.

Do not exceed the GVWR of the vehicle. Crash survivability, tire size, handling, and durability are all determined for the GVWR. Exceeding the GVWR will negatively impact the above and increase tire wear.

Estimating Performance

Kinetic energy is equal to mass of the vehicle times the square of the velocity divided by two. Ke = MV^2/2. Energy from the motor equals 550 ft lb./sec for each horsepower. To calculate acceleration performance, multiply maximum (80% average peak motor output times drive train efficiency) times 550 divided into kinetic energy.

Example:

30 mph = 5280 (feet per mile) x 30 mph / 3600 (seconds per hour) = 44 ft per second.

Ke = 3200 lb. (GVWR for 89 Escort) / 32 (32 = gravitational constant to convert lb. to units of mass, slugs) x (44)^2 =96,800 ft lb.

Performance

A 20 horsepower electric motor has a peak horsepower of about 80 hp. 96,800 /(80 x .75 x 550) = 2.9 sec for 0 to 30 mph. This assumes that the wheels do not spin at low speeds. This is not the case in reality, therefore, actual acceleration time will be slightly longer.

Performance, 0 to 60

Ke = 3200/32 x (88)^2 = 387,200

387,200/(80 x .75 x 550) = 11.7 sec.

Any time above 16 seconds is considered a hazard when merging into freeway traffic.

Remember that volts X amps = watts and 1000 watts = 1 kilowatt (kw). One horsepower = 1000 watts or 1 kW from the battery. This assumes nominal battery voltage and the efficiency of the battery, cable, converter and motor combined is 75%.

Your motor cannot put out any more horsepower than the battery and controller can supply, therefore it is wise to select the controller accordingly. If you want 80 HP peak from your motor, then your controller should be capable of providing at least 80,000 watts or 80 KW.

Manufacturers using the metric system rate the mechanical output of electric motors in kilowatts (kW). One kW is equal to 1.34 hp.

Example:

For a 120 volt system, 80 hp requires:
(80 hp x 1000 VA/hp) / 120 V = 667 A

For a 96 volt system 80 hp requires:
(80 hp x 1000 VA/hp / 96 V = 833 A

Balance

The sticker located near the driver's door contains the Gross Axle Weight Rating (GAWR) in addition to the GVWR. Do not exceed these ratings. For maximum drivability the center of gravity and moment of inertia should be as low as possible. Also, the left side weight should equal the right side for each axle.

A low center of gravity makes the car resistant to tipping. During hard cornering the car with a low center of gravity will tend to skid. A car with a high center of gravity will tend to roll over. Thus, a low center of gravity car is more forgiving when cornering.

A low polar moment of inertia makes the car highly maneuverable. This is referred to as quick or responsive handling.

A high polar moment of inertia makes steering the car feel like steering a boat. This is referred to as stable handling.

This means that the weight should be located as close to the ground and as close to the center of the vehicle as possible for quick handling. This is why the RAV-4 and the Honda EV mount their batteries under the floor of the passenger compartment.

The polar moment of inertia (I) is the weight times the distance (l) from the center of rotation squared. $I = (m1)^2$ Assume that the center of rotation is the center of the vehicle. Measure the distance of each component to the center of the vehicle. Square it. Multiply by the weight. Add up this number for all components, including driver and passenger(s). Try different layouts to minimize this value.

The trick is to locate the drive train components where they can obtain the required cooling while remaining serviceable while maintaining a low center of gravity and moment of inertia.

Aesthetics

If you are going to use this vehicle for commuting, try to make it look as much like a factory manufactured vehicle as possible. People will be judging the suitability of electric vehicles by your vehicle. Aesthetics sell cars. Poor workmanship, empty holes and jagged edges all leave negative impressions on passengers. They begin to question what other short cuts may have been taken that may compromise safety.

Safety

We all tend to forget about accidents; however they happen. Detroit takes crash safety seriously. Their cars have to pass rigorous tests. One such test is a rollover test. The vehicle is rolled on its side and roof and cannot leak more than a small amount of fuel.

Think of yourself in such a situation. Even though battery acid is fairly dilute, you wouldn't like it dripping on you or dripping on the car and weakening the structure. Keep the batteries away from the crumple zone. This is the area that gives, to reduce the forces on the occupants during a crash. If a car didn't give car accidents would resemble billiard balls bouncing off of each other. You can imagine what your neck would be doing if you were inside of a billiard ball when it hit another one.

Provide containers around the batteries to contain any battery acid spillage. The challenge here is to prevent leakage of the acid while providing ventilation during charging. This takes ingenuity and is one area of expertise that the "little guy" can explore.

You may also want to consider the consequences of using wood in the interior. Wood tends to splinter under the stress of an accident, creating sharp edges to impale passengers.

Conclusion

A light, low drag coefficient, low frontal area, late model vehicle, large enough to carry the powertrain is what is needed for your conversion. You also need to keep the center of gravity and moment of inertia low. Now you know what to look for in a chassis. Happy hunting!—BP

EAA Chapter Listing (10/96)

ARIZONA
Phoenix (PHNX)
Jesse James (Pres.) (602) 250-2131
P. O. Box 40153, Phoenix, AZ 85067-0153
Meetings: 4th Saturday @ 8:30 AM
Arizona Public Service Center, 400 N. 5th St.
Phoenix, AZ

Tucson (TEVA *)
Tucson Electric Vehicle Assoc. *
Don Traicoff (Pres.) (602) 622-7856
P. O. Box 77538, Tucson, AZ 85073
Meetings: Contact Don for time and location

BRITISH COLUMBIA, CANADA
Vancouver (VEVA *)
Bill Glazier (Pres.) (604) 980-5819
Vancouver Electric Vehicle Assoc.
1402 Charlotte Rd.,North Vancouver, BC V7JIH2
Meetings: 3rd Saturday 7:30 PM
B.C. Business Cafeteria
Contact Bill for details

CALIFORNIA
East Bay (EBAY)
Scott Cornell (Pres.) (510) 685-7580
60 Alan Dr.,Pleasant Hill, CA 94523-1902
Meetings: 2nd Saturday 10:00 AM
Hangar 20 (CALSTART), Alameda Naval Air Station
Alameda, CA

Los Angeles (BUR)
Irving L. Weiss (Pres.) (818) 841-5994
2034 N. Brighton "C", Burbank, CA 91504
Meetings: 1st Saturday 10:00 AM
Cal Tech - Winnet Lounge
Pasadena, CA

North Bay (NBAY)
Chuck Hursch (Pres.) (415) 927-1046
13 Skylark Dr. # 17,Larkspur, CA 94939-1270
Meetings: 3rd Saturday 9:45 AM
North Bay Savings and Loan, 20 Petaluma Blvd.
Petaluma, CA

Riverside
Dr. Jea Park (Pres.)(909) 309-3060
25988 Reynolds St Loma Linda, CA 92354
Meetings: 4th Saturday 4:00 PM
International Lounge, University of CA.
Riverside, CA

Ontario (EVAOSC *)
Electric Vehicle Assn. of So. CA
P. O. Box 16 Downtown, Ontario, CA 91762-9998
Meetings: 3rd Saturday 10:00 AM
Ontario Public Library, 215 East C St.
Ontario, CA

Peninsula (PEN)
Henry Deaton (Pres.)(415) 861-5624
198 Dolores St. # 4, San Francisco, CA 94103
Meetings: 1st Saturday 10:00 AM
San Bruno Public Library, 701 W. Angus @ El Camino
San Bruno, CA

Sacramento (SEVA *)
Sacramento Electric Vehicle Association
Mark Bahlke (Pres.) (916) 356-6767
8619 Posadera Ave.
Orangevale, CA 95662
Meetings: 2nd Saturday 9:30 AM
SMUD Building, 6201 S St.
Sacramento, CA

San Diego (SDGO)
Ron Larrea (Pres.) (619) 443-3017
9011 Los Coches Rd.,Lakeside, CA 92040
Meetings: 4th Saturday 7:00 PM
San Diego Auto Museum, 2080 Pan American Plaza
San Diego, CA

San Jose (SNJ)
Don Gillis (Pres.) (408) 225-5446
5820 Herma St., San Jose, CA 95123-3410
Meetings: 2nd Saturday 10:00 AM
Contact Don for meeting location

Silicon Valley (SVLY)
Bob Murray (Pres.)(415) 321-7241
859 Graland, Palo Alto, CA 94303
3rd Saturday 10:00 AM
H.P. Facility, 5301 Stevens Creek Bl.
Sunnyvale, CA

COLORADO
Denver (DEVC *)
Denver Electric Vehicle Association
George Gless (Pres.) (303) 442-6566
2940 13th St. Boulder, CO 80304
Meetings: 3rd Saturday
Contact George for time and location

DC (WASHINGTON)
Washington, DC (EVADC *)
Electric Vehicle Assoc. of Greater Washington D.C.
David Goldstein (Pres.) (301) 869-4950
9140 Centerway Rd., Gaithersburg, MD 20879
Meetings: 2nd Tuesday 7:00 PM
Contact David for location

FLORIDA
South Florida (FLA)
Bill Young (Pres.) (407) 269-4609
P. O. Box 156
Titusville, FL 32781-0156
Meetings: Contact Bill for date, time, and location

HAWAII
Honolulu
EVA of Hawaii *
David Rezachek, P.E. (Pres.) (808) 524-1954
710 Lunolilo St., Ste. 1107, Honolulu, HI 96813
Meetings: Contact David for date, time, and location

MASSACHUSETTS
New England (NENG)
Bob Batson (Pres.)(508) 897-8288
1 Fletcher St., Maynard, MA 01754
Meetings: 1st Saturday 1:00 PM Mar, Jun, Sep, Dec
Contact Bob for location

Pioneer Valley
Karen Jones (Pres.)
P. O. Box 153, Amhurst, MA 01004-0153
Meetings: 3rd Saturday 2:00 PM
Amhurst Room - Jones Library,Amity St.
Amhurst, MA

MISSOURI/KANSAS
Mid America
Bill Roush (Pres.)(913) 362-2404
13700 108th St.,Lenexa, KS 66215
Meetings: Contact Bill for date, time, and location

NEVADA
Las Vegas (LVGS)
Gail Lucas (Pres.)(702) 736-1910
P. O. Box 19040, Las Vegas, NV 89132-0040
Meetings: 3rd Tuesday 7:30 PM
Desert Research Institute
Flamingo at Swenson
Las Vegas, NV

NORTH CAROLINA
North Carolina Triangle
Jerry Asher (Pres.)(919) 403-8137
4 Melstone Turn, Durham, NC 27707
Meetings: 2nd Tuesday 3:00 PM Odd Months
Conference Room, IEL Lab, Centennial Campus, NC State Univ.
(call Jerry for details)

Southeastern (SEEV)
Lawson Huntley (Pres.)(704) 283-1025
P. O. Box 1025, Monroe, NC 28111
Meetings: Contact Lawson for date, time, and location

NEW JERSEY
Tri-State (NJTS)
Kasimir Wysocki (Pres.) (201) 343-1252
293 Hudson St.,Hackensack, NJ 07601
Meetings: Quarterly, contact Kasimir for date, time, and loc.

NEW MEXICO
Albuquerque
Dale Riddle (Pres.)(505) 260-0070
603 Florida St. SE
Albuquerque, NM 87105
1st Wednesday 7:00 PM
Int'l House of Pancakes,Gibson just east of San Mateo
Albuquerque, NM

OREGON
Tualatin
OR EV Assn. *
Lon Gillas (Pres.) (503) 434-4332
505 W. 25th St., McMinnville, OR 97128
Meetings: 2nd Wednesday, even months
Energy Resource Center, 7895 SW Mohawk Center
Tualatin, OR (503) 694-6020

TEXAS
Houston (HOUS)
Ken Bancroft (Pres.)(713) 729-8668
4301 Kingfisher St.,Houston, TX 77035
Meetings: 3rd Saturday 12:00 PM
Ken's Place, 4301 Kingfisher St.
Houston, TX

North Texas (NTEAA)
Charles Wilson (Pres.)(214) 393-0719
158 Edgewood, Coppell, TX 75019
Meetings: 3rd Thursday, odd months
Contact Charles for time and location

UTAH
West Valley City (WVC)
Harry Van Soolen (Pres.) (801) 969-1130
3622 S. 4840 W., West Valley City, UT 84120
Meetings: Contact Harry for date, time, and location

VIRGINIA Central (CEVA)
Jim Robb (Pres.)(804) 342-0925
3106 Porter St., Richmond, VA 23225
Meetings: 3rd Wednesday 7:00 PM
Science Museum of Virginia, 2500 W. Broad St.
Richmond, VA

WASHINGTON
Port Townsend (NOPECC *)
North Olympic Peninsula Electric Car Club *
Karl E. Schreiber (Pres.)(360) 231-3991
11 Kanu Dr.,Port Townsend, WA 98368
Meetings: Contact Karl for date, time, and location

Seattle (SEVA *)
Seattle Electric Vehicle Assoc.
Ray Nadreau (Pres.) (206) 542-5612
19547 23rd N.W., Seattle, WA 98177
Meetings: 2nd Tuesday. Contact Ray for time and loc.

* means independent but affiliated with EAA Electric Auto Association and Affiliated Groups'Chapter Contacts and Meeting Locations as of 10/96

For Information about the Electric Auto Association, call 1-800-537-2882

EAA Membership Application (10/96)

Electric Auto Association

All information and statistics in this application are for the exclusive use of the EAA.
Note: EAA membership dues are tax deductible as allowed by the IRS.

New member ☐
Renewal ☐
Date: ___ / ___ / ___

US ☐ $35
Canada ☐ $40 USD
Other ☐ $45 USD

Name ______________________
Street ______________________
City ______________________
State ________ Zip: ________ - ____
(Please use 9-digit code.)

Co Name ______________________
Phone ( ) - x
Fax ( ) -
Country & Code ______ / ______

EAA Chapter you attend or support ______________________
I need chapter information! ☐
If new member, where did you hear about EAA? ______________________

Member/Vehicle Information (Please complete if new or changed.)

Professional Background ______________________ Age: ______ Sex: M/F

Please identify your primary areas of interest.

(Please rank choices with "1" being the most important, "2" second, etc.)

☐ 1 Hobby / Builder
☐ 2 Professional (EVs are a source of income for you.)
☐ 3 Competition (Rallies, Races and Records)
☐ 4 Environmental and Government Regulations for EVs.
☐ 5 Social (Rallies, Shows, Dinners, other)
☐ 6 New Technology and Research
☐ 7 Promotion and Public Awareness of EVs
☐ 8 Student or general interest
☐ 9 Electrathon / Bicycle / Off-road vehicles
☐ 10 Owner/Driver of electric commute vehicle
☐ 11 Other: Please specify. ______________________

Number of Electric Vehicles you have ever owned? ______
Number of EVs you now own. ______

Describe any Electric Vehicle you now own or are buildin
(If more than one, please attach information for each.)

Veh. Lic ______ State ______
Vehicle Type ______ Model Yr ______
Make ______ Build/Convert Yr ______
No. Wheels ______ Motor ______
Batteries (Number/Type) ______ Pack Volts ______

% Complete ______
Controller ______
Avg. EV Mi./Wk ______
Avg. EV Trips/Wk ______

Other Features: ______________________
Comments: ______________________

News in Brief

News in Brief is compiled by Ruth M. Shipley from information supplied by Environmental Information Networks. If reprinted, please credit CE and Ruth Shipley.

EV Industry Meets in Japan

After years of being on the fringes of the auto industry, EVs are poised to join the mainstream, according to delegates at the 13th International EV Symposium (EVS-13) in Osaka, Japan. And if the cost of EVs can be cut from today's level of about 3 times that of conventional gasoline-powered vehicles to no more than 1.5 times, their sales would take off, according to Toyota chairman Shoichiro Toyoda. With more than 1,650 participants, EVS-13 drew the largest crowd in the history of the biennial conference. While all the major Japanese carmakers, the Big Three and Peugeot-Citroen were represented, most German, Swedish and Italian carmakers were no-shows. US automakers have chosen to go with lead-acid batteries for now, but most Japanese carmakers will offer cars with NiMH batteries.

(AUTOMOTIVE NEWS: 10/21)

SwRI Reconfigures Fuel Cells

Southwest Research Institute (SwRI) of San Antonio, TX is investigating alternatives to the channeled carbon plates that generally serve as electrodes and flow path manifolds in PEM fuel cells and is developing new cell architectures. The Institute has assembled and tested several prototype PEM fuel cells using new cylindrical designs, based on the hypothesis that cylindrical cells can overcome some of the weaknesses caused by the flat plate geometry of existing designs. SwRI has designed and assembled three types of cylindrical PEM fuel cells — rolled sheet, solution cast and sputter-coated. While the rolled sheet technique proved simplest for constructing a cylindrical fuel cell, the solution casting approach eliminated the problem of clamping pressure by forming three layers from solutions into one composite structure.

(BATTERY & EV TECHNOLOGY: OCTOBER 1996)

Ethos 3EV Unveiled at Symposium

Unique Mobility, Inc. of Golden, CO and Italy's Pininfarina unveiled their collaborative electric vehicle effort, the Ethos 3EV, at the 13th Electric Vehicle Symposium in Osaka, Japan. The Ethos 3EV is a four-door hatchback designed for city commuter driving, powered by Unique Mobility's 53-kilowatt UQM powertrain and Ovonic nickel-metal hydride batteries. The car has a top speed of 78 mph and can travel 150 miles on a charge. "Our vision, in collaboration with Unique Mobility, was to create a family of clean vehicles which could be industrialized, sold and distributed by our traditional automotive clients for sale to the general public in several configurations in many markets," said Pininfarina representative George R. Ryder, Jr.

(PRNEWSWIRE: 10/11)

CALSTART Unveils EV Prospectus

To support and track progress and opportunities in the EV industry, CALSTART has unveiled a "prospectus" on the EV industry markets, technologies and strategies, in addition to a comprehensive listing of clean fuel vehicles. "Electric Vehicles: An Industry Prospectus" provides investors, analysts and companies with valuable industry intelligence. The "Advanced Transportation Vehicle Catalog" lists electric, hybrid-electric and natural gas vehicles that are available or in development worldwide. To access the service, visit CALSTART's Web site at http://www.calstart.org and click on "Advanced Transportation Vehicle Catalog" under vehicle services. To obtain a copy of the prospectus, contact CALSTART at 818-565-5600.

(BUSINESS WIRE: 10/14)

British Experiment With EVs

British transportation secretary George Young recently announced the initiation of the first EV demonstration project in a British city. The project, to be carried out in the Midlands city of Coventry, will involve EVs manufactured by French automaker Peugeot. The Coventry program is similar to a project in the French city of La Rochelle, in which 50 electric-powered Peugeot 106 automobiles were used by public and private drivers between 1993 and 1995. The Coventry program will involve only 14 vehicles. Users from the Coventry City Council, East Midlands Electricity, PowerGen and the Royal Mail will purchase the vehicles and evaluate their performance. Depending on the success of the program, Peugeot says the all-electric 106 could go on sale in England by 1997.

(FINANCIAL TIMES: 10/15)

GM Announces Lease Program

Saturn Corp. recently announced that it will lease the General Motors EV1 on a 36-month GMAC program for $33,995 beginning December 5. The EV1 will be available at Saturn's 26 retail facilities in Los Angeles, San Diego, Phoenix and Tucson, AZ. The vehicle's capitalized lease cost could be reduced to $30,595 through the use of a 10% federal tax credit. "Buy down" credits and discounted annual registration fees also provide additional savings, depending on the location of the lease. The lease program will include a 3-year/36,000-mile "bumper-to-bumper" new car limited warranty. Based on capitalized cost examples of $25,595 and $30,595 respectively, the approximate monthly payments would be between $480 and $640 per month. For further information, phone 1-800-25-ELECTRIC, or access the EV1 web site at http://www. gmev.com.

(PRNEWSWIRE: 10/15)

Hy-Stor Battery Ready for EVs

Ergenics, Inc. of Ringwood, NJ has achieved a major milestone in its rechargeable battery development program with the demonstration of its first

Hy-Stor multi-cell bipolar metal hydride battery for EVs. Because the battery reportedly provides much longer cycle life, much greater range between charge cycles, a greater temperature range of operation and substantial cost efficiencies, Ergenics said it will initially target the electric and hybrid vehicle markets. The Hy-Stor battery will provide an EV with more than double the range between recharges of currently available lead-acid batteries and 20% greater range than NiMH batteries, at equivalent levels of acceleration performance. The battery has a life of 2,000 cycles at 100% discharge, 100,000 cycles at 15% discharge and high power pulse capacity.

(ERGENICS RELEASE: 10/15)

Saft Tests Lithium-Carbon Battery

The lithium-carbon battery may make EVs a commercial reality if testing to be conducted at a European laboratory goes as expected. While the technology —also known as lithium-ion — is already used in small batteries, large batteries that require new manufacturing techniques are needed for an EV. Under the Vedelic project, French battery maker Saft, Peugeot and the Heuliez Group in western France are working to build a prototype EV using the technology. The companies hope to have a Peugeot 106 powered by a lithium-carbon battery next summer. Saft is aiming for commercial production of the batteries in 2001-2002 if there is a market. Lithium-carbon has the potential of twice the range of nickel-cadmium batteries at a lower price.

(AUTOMOTIVE NEWS: 10/4)

Zinc-Air Battery Sets Record

Jerusalem-based Electric Fuel Corp. recently announced that its zinc-air battery system set an EV endurance record by propelling a Mercedes-Benz van over the Alps. The van was driven from Chambray, France to Electric Fuel's refueling facility near Turin, Italy, a distance of 152 miles. During the trip, which included a 93-mile continuous climb, the vehicle used only 65% of the capacity from a single charge of the 150 kWhr zinc-air battery. "By testing the vehicle in continuous mountain driving, we were able to confirm that the zinc-air battery contains the necessary sustainable power and energy for any driving condition," said Electric Fuel president and CEO Yehuda Harats. Contact Mike Greece or Malkie Bernheim of G.S. Schwartz and Company, 212-725-4500.

(ELECTRIC FUEL RELEASE: 10/14)

Nissan to Introduce Electric Van

Nissan recently announced that it will offer a new EV to California fleets in early 1998. The Nissan EV is a four-passenger compact van that can utilize either a gasoline engine or an electric motor. Nissan and Sony Corporation jointly developed the vehicle's lithium-ion batteries, which produce 100 Whrs per kilogram of energy. The batteries have about 3 times the energy density of conventional lead-acid batteries and a life of approximately 1,200 charge/discharge cycles. The vehicle will use an inductive charging system and will feature a permanent magnet synchronous motor and a new 32-bit high-speed controller processor. It can travel 120 miles on a charge and boasts acceleration capabilities that match gasoline-powered vehicles.

(PRNEWSWIRE: 10/14)

Book Details GM EV Program

A new book from Random House chronicles the development of the General Motors EV1. Titled "The Car That Could", the book was written by reporter Michael Shnayerson, who was given complete access to the company's EV project in 1992 without the knowledge of then-president Jack Smith or other company executives. The book chronicles the somewhat rocky beginnings of the GM EV program, including the failure of efforts to negotiate a joint venture to develop Evs with Ford and Chrysler. Financial problems nearly dealt the program a blow, too. GM needed the $270 million required to get the EV program up and running for other projects, and Smith reportedly even told GM chairman Robert Stempel, a supporter of the Impact, "Bob, you can't afford it."

(KNIGHT-RIDDER/TRIBUNE BUSINESS NEWS: 10/5)

EV Calendar

BY KAWATSON, PHOENIX EAA

Welcome to the Electric Auto Association calendar of events. Listed are events of direct or related interest to electric vehicle enthusiasts and alternative transportation technology businesses. If you knew of an event that should be listed, please email detailed information to kawatson

1996

Dec. 2-5

2nd SAE Global Vehicle Development Conference, Detroit, Michigan. Symposium featuring 70 presentations from industry leaders on global automotive topics including vehicle development, sourcing and regulatory issues. Held at the Westin Hotel, Detroit — Under the sponsorship of the Society of Automotive Engineers. Contact: SAE Promotions, tel. 412-772-7131, email meetings@sae.org

Dec. 7-8

Desert Electric Classic, Tucson, Arizona. Location: Davis Monthan Air Force Base, featuring the High School Challenge Series. Contact Electric Vehicle Technology Competitions, Ltd. (EVTC)in Phoenix, Arizona at tel. (602) 256-2599, fax (602) 256-2606.

Dec. 11-13

1996 North American EV & Infrastructure Conference, San Diego, CA. Symposium, exhibition, ride'n-drive, held at the Sheraton San Diego Hotel and Marina. Sponsored by the Electric Vehicle Association of the Americas. Exhibitors include, AC Propulsion, AeroVironment, Honda, CARB, Calstart, Chrysler, Delco Electronics and Propulsion, EcoElectric, Ford, GM, Hawker, Ovonic, Saft America, Solectria, Toyota, DOE, Unique Mobility, Wyle Labs and many others. For anyone interested in copy of the 10 page program email Pam Turner Conference Manager at firstopt@aol.com Contact: EVAA, 601 California St. Ste. 502, San Francisco, CA. 84108, tel. 415-249-2690, fax 415-249-2699. Web site located at http://www.evaa.org

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1997

Feb. 24-27 1997

SAE International Congress and Exhibition, Detroit, Michigan. Annual conference and exhibition sponsored by the Society of Automotive Engineers, held at Cobo Center, Detroit. Contact: SAE, 400 Commonwealth Dr., Warrendale, PA. 15096-0001. Tel. 412-772-7131, fax 412-776-0002, email meeting@sae.org or visit SAE Web site at: http://www.sae.org

March 7-9

APS Electrics, Phoenix, Arizona. EVTC conducts electric vehicle competitions as a means to increase public awareness of electric vehicles, develop an electric vehicle educational infrastructure and advance EV technology, all in an effort to support commercialization of electric vehicles in accordance with Energy Policy Act mandates.
EVTC competitions provide laboratories for High School and University students to work out real life solutions to textbook problems. Location of EVent: Firebird International Raceway. Classes (additional classes maybe added however):ABB University Spec Series, Formula E Class, Prototype Demonstrations, High School Challenge Series, Street Stock Class Super Stock Class. Contact: EVTC, tel. (602) 256-2599, fax (602) 256-2606

Apr. 7-10

EnV'97, Detroit, Michigan. Fifth annual Environmental Vehicles Conference and Exposition is held concurrently with the 12th Annual Advanced Composites and 6th Annual Advanced Coatings Technology Conferences and Expositions at the Westin Hotel. Sponsored by The Engineering Society of Detroit and SAE. For more information on the 5th Annual Environmental Vehicles Conferences, Contact: Kristin Karschnia, ESD, 29355 Northwestern Hwy., Suite 200, Southfield, Michigan, 48034, tel. 810-355-2910, fax. 810-355-1492.

Apr. 20

Contra Costa Earth Day at the Concord Pavillion in Concord CA. Hours, 10AM-6PM. They are looking for EVs to show. In previous years attendance has exceeded 30,000. Contact Anna Cornell, EAA Events Coordinator, (510) 685-7580.

The intent of this calendar is to provide a comprehensive list of events that will help to increase awareness and participation in the ever-growing interest in and use of Electric Vehicles. Your support and input is greatly appreciated. Thank you.

Produced by kawatson (evchdlr@primenet.com)

Letters to the Editor

Dear Clare,
This is a long delayed thanks (partly cuz for some strange reason you never publish your e-mail address in Current EVents [smart!]). A few months ago you published a bit about the disconnect switch on Jet conversions grounding out. I've got a 1980 Courier truck conversion, and sure enough the grommet on the emergency disconnect had rotted away. When my BC-20 started tripping off the GFI a couple weeks ago I knew just where to go looking. Thanks!
BTW, Current Events is lookin really good lately. Bigger, more meaty. It's a delight every month.

Best Regards,
Doug Pratt, (Dr. Doug)
Real Goods Technical Editor
doug@realgoods.com

HEATING BATTERIES

Several people have been asking about heating their batteries because of freezing temperatures. REV Consultants Ltd. is a CANADIAN Conversion Company which specializes in winter operation of electric vehicles. We have battery heaters in 50 Watt, 30" long, and 80 Watt 36" long sizes. They are self insulated and packaged in an acid proof liner, can be installed directly under the batteries in 3/8" space. $ 20.00 each.

Call for information: REV Consultants LTD,(613)722-9939 or fax (613) 722-9890, Rick Lane. Consulting services also available to design your insulated box.—RL

Source: Micheline Daigle <daigmic@STATCAN.CA>

FOR EAA MEMBERS

EV Want Ads

For Sale: '82 Lectra 2-Dr. Hatchback.

Professional Lectra Factory conversion from a new 1982 Datsun 2+2 SL, Mesa tan color. Only 242 miles on car. Tires like new. Never driven or registered as a gasoline car. Comes complete with with spare Prestolite 96V motor and Lester charger. Car needs electrical disassembly, total cleaning of all parts electrical and cosmetic. Needs all new batteries, cables and 2 matching front bucket seats (missing). Good project car and good deal at $2600. Includes detailed factory manual. Call Ted @ (619) 365-6146. (Yucca Valley, California)

Member Want Ads

Print clearly or submit typed copy of your ad with your name, address, and phone number. The EAA is not responsible for the accuracy of ads. Want ads must be received before the 1st of each month and must include payment to run in the next issue of CE.

$10 for the first 35 words. Each additional word, 25 cents. Want Ads are available to EAA members for the sale of electric vehicles, equipment and parts only. If you want to run your ad in more than one issue, please specify and include payment for each issue requested.

For corrections or updates, please send a written note or fax to EAA Want Ads @ 408.374.8750. Photographs of your vehicles may be submitted with your ad. If room is available, we run one photo each issue. These photos will not be returned.

Send your Member Want Ad request and check made payable to: EAA Want Ads, 18297 Baylor Avenue, Saratoga, CA 95070

May you have a peaceful, safe,and loving holiday season.— Susan Hollis (PCTEK)

AD RATES (12/96)

Full page	**7.25" x 9.25"**
1 ad	$400 ea
3 ads	$300 ea
12 ads	$250 ea
1/2 page	**7.25" x 4.50"**
1 ad	$250 ea
3 ads	$175 ea
12 ads	$125 ea
1/4 page	**3.50" x 4.50"**
1 ad	$200 ea
3 ads	$150 ea
12 ads	$100 ea
1/8 page	**2.0" x 3.5"**
1 ad	$150 ea
3 ads	$100 ea
12 ads	$75 ea

Ads may be placed for 1, 3 or 12 months. Camera-ready copy for each ad must be submitted along with payment. Ads may be submitted on diskette in TIF or EPS format on the PC or MAC. For 12 ads, an invoice will be billed quarterly. A minimum of 3 ads need to be prepaid per quarter.

Ad Deadline

The Deadline for camera-ready copy is the **1st of the month**. Copy received after the 1st will be run in the next issue. Ads will be placed in the priority received. Prepaid ads will receive 1st priority.

Advertising Manager

Susan Hollis, AdvertisingManager
Office: (408) 374-8605
FAX (408) 374-8787

Address

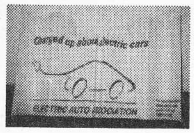
Make check payable to EAA. Camera-ready copy and payment for the ad should be sent to:

Electric Auto Association
18297 Baylor Avenue
Saratoga, CA 95070

CE ADVERTISERS

EAA **Reprint** Order Form

100% Cotton Cap
Forest Green
'Charging into the Future' EAA Logo
CAP001......$7.50



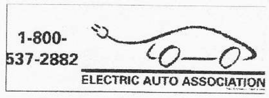
Auto SunShade
SS001..............$8.00

T w/EAA Logo
(adult small only)
TS001....$14.50

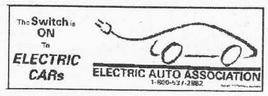
Thermal Auto Mug
MUG02...$6.00

Porcelain Mug with 'Charging into....Future'
MUG003.....$5.00

Window decal 'The Switch is on to Electric Cars' Black and Red printing. 3 x 9 inches
DC001..........................$3.00



Bumper sticker 3.75 x 15 inches
BS800..........................$2.50



Bumper sticker 3.75 x 15 inches
BS002..........................$2.50

EAA Key Chain , actual shape may vary
KC001.......................$1.50

Printed materials

CE	Selected Current EVents ***(specify specific issue)***	$ 3.00 each issue
CEFY	Current EVents - Full year ***(specify specific year)***	$20.00 each year
PB001	Discovered:The Perfect EV Battery	$ 2.00
FW001	Flywheel Energy Storage	$ 5.00
BG1996	1996 Buyer's Guide to Electric Vehicles (Feb 96 issue CE)	$ 5.00
BG1995	1995 Buyer's Guide to Electric Vehicles (Feb 95 issue CE)	$ 5.00
TT001	Team Tucson Land Speed Record Plans	$ 5.00
IDX001	EAA Current Events Index - 10 Years!	$ 4.00
XA100	EAA XA-100 Hybrid	$ 5.00

Other EV Items

PN001	Ball point pen with "EAA, 800 phone # & Charging....Future"	$ 1.00
CS001	Current Solutions/Motor Show Video Tape (14 minute runtime)	$14.00
WL001	Window Literature Holder (fits pages 8.5 x 11 inch)	$22.00
PARK01	"EV Parking Only" Sign (18"x12") green icon on white background	$22.00

Electric Auto Association **Reprint** Order Form
Send order to: EAA Reprints
5820 Herma St., San Jose, CA 95123-3410

Name____________________
Address____________________
City,St,Zip____________________

Item#	Size	Quantity	Item Description	Unit Cost	Amount

Make check payable to: **EAA** (US dollars)

Subtotal	
Postage (10% of subtotal, for USA*)	
Handling	$2.00
Total	

* for Canada add 15% or for other foreign destination add 25%

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ELECTRIC AUTO ASSOCIATION

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