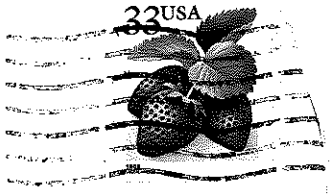
Fox Valley Electric Auto Association
1522 Clinton Place
River Forest, IL 60305-1208



Address Correction Requested

David B Aarvold
915 Oak Street
DeKalb IL 60115 -3470

60115-3470 04

NEXT MEETING: Friday, October 15 at 7:30 PM at Triton College. 2000 Fifth Avenue Industrial Career Building, B-200. See location map in this Newsletter.

DISCUSSION TOPICS - 1. Future projects. 2. New officers and directors for Y2K. 3. New information about theMeyer battery charger. 4. Performance paper, Part II

MEMBERSHIP INFORMATION

Any person interested in electric cars is welcome to join the FVEAA. The cost for a full year's dues is $20 which will entitle the member to receive our monthly Newsletter that contains useful information about electric car components, construction, policies and events.

To obtain information about the FVEAA, you may contact either President Woods or Vice President Shafer:

President - Ken Woods
1264 Harvest Court
Naperville, IL 60564-8956
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E-mail Casa Zeus2@aol.com

Vice President & Editor - Bill Shafer
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October [illegible]

1. Our next meeting will the first at Triton, our new location. Thanks to members Ray Oviyach, Bill Shafer, and to Triton President, Dr. George Jorndt. We look forward to future cooperation with Triton. We will discuss future projects to suggest to Triton.
2. Our fiscal year ends in November. The next newsletter will contain a $ 20 renewal application for 2000. Also that will be time for election of officers. If someone is willing to serve as an officer or director let me know. Past presidents make up the nominating committee.
3. Member Meyer will have some interesting information to tell us about his battery charger.
4. Bill Shafer will lead a discussion of ***Performance, Part II.***
5. We plan to have our November meeting on **Saturday, Nov 19 at 10:30 AM** at Warfield Electric, a motor manufacturer in Frankfort, IL.. Note the special date.

See you at Triton.

Ken

MINUTES OF SEPTEMBER MEETING

The meeting in Ed Meyer's hangar was called to order by President Woods at 7:45 PM. Thirteen members and two guests attended. Member Larry Obilia flew in from his home in Weyauwega, WI with two guests.

The minutes of the September meeting were approved with one correction - John Emde is an honorary crew **member** of the dragster group.

Treasurer Corel's report that their was $ 2481.06 in the savings account and $ 2130.77 in the checking account was accepted.

There was discussion of ;sponsorship of ***Bad Amplitude.*** Member Kevin Zak indicated while the dragster group might like to put the FVEAA logo on the car, they were not seeking FVEAA sponsorship at this time.

There was also discussion of the proposal that members of dragster group who had put FVEAA information on the Web would be willing to update and make changes in that material. A suggested quid-pro-quo could be a concession offered to dragster group memberships. A resolution that the FVEAA waive $ 100 in membership fees in return for ;web page upgrading and maintenance was approved. The subject will be again discussed when additional dragster members familiar with the page attend a future FVEAA meeting.

Member Zak brought a Warfield electric motor to the meeting. It was examined by members and its construction discussed. Warfield Electric is in Frankfort, Illinois. It was suggested that the FVEAA hold a meeting at the Warfield facility, perhaps on Saturday, November 10th at 10AM in place of the regular meeting scheduled for the preceding day. The idea was approved.

The Warfield motor is similar to the Advanced DC Motor several members have used in their projects. It is a 4-pole series-wound motor and has several design improvements over the Advanced Motor.

Member Zak described the continued Kostov motor failures. These were discussed by the membership. A particular difficulty is the Bulgarian location of the manufacturer and getting replacement parts. In one failure, an arc apparently started in the armature and was communicated to the stator, melting a substantial hole in frame and field windings.

Member Paul Polster wants to build a 3-wheeled vehicle. There was a spirited discussion of design and construction ideas. One proposal was to cut the front end off a Geo *Metro* and build a "boatail" extension in back of the front seat. This presents the challenge of how to structurally add a battery rack and to provide structural integrity and keep an acceptable weight distribution. Another suggestion was to start with a battery pack, the major weight component, and weld a tubular steel frame around the battery carrier with appropriate ground clearance in the middle of the vehicle. There will be other discussions of this project at FVEAA future meetings

Member Shafer reported a battery charger failure. It occurred while he was driving his Mazda RX-7 to the Berwyn *Historic Route 66 Car Show.* He heard a "pop" while driving but it had no effect on the car. This was later followed by a second, and louder "POP". After returning home, he found the charger was smoked up. He brought the unit back to Ed Meter for an autopsy.

The meeting was adjourned at 10:15 PM.

From the notes of Bill Shafer

RECENT ARTICLES ABOUT ELECTRIC VEHICLES

Member Larry Claypool sent to me the August/September issue of ***The Renault News***, a publication by Renault Owners of North America. (Website www.dreamsoft.com/renaultclub) that had an article about the **HENNY KILOWATT.** This electric car was adapted from a Renault Dauphine in 1960. The article describes the electrical components used. Two EV owners had asked me previously about Kilowatt restorations.

The Northeast Sustainable Energy Association (NESEA), best-known for their annual Tour de Sol events, is sponsoring two interesting workshops. The first is on Friday, November 5th at the New Hampshire Technical Institute in Concord, NH covers "Building a Successful Electric Vehicle Program at your School. The second on November 6th at the same place will cover EV & Hybrid EV fundamentals at the High School level. These sessions are sponsored by the NH Governor's off of Energy & Community Services, the US EPA, the NH Department of Environmental Services, and a few commercial firms. (Editor's note - sounds similar to our proposed May Workshop)

Back to the Future. The *Amicus Journal,* Fall 1999, Pages 17-24. This article asks the question, "Can Modern Science Make a Car as Green as Fed Flintstone's?" It begins with a description of a car propelled by compressed air (CA). The air compressor would be powered by solar panels mounted on a garage roof. The CA vehicle may turn out to be an aberration because most Americans want cars that look and drive like the cars they have always known.

Lester Lave, head of the Green Design at Carnegie Mellon, say's "There are no miracles around.'". Tomorrow's cars may be cleaner but odds are they will still run on gasoline or diesel fuel. In a recent industry survey, it appears that auto manufacturers expect hybrid cars to make up 5% of the total market in about five years.

The Green Car ear began in 1969 with the EV prototype developed by AeroEnvironment for GM. This later appeared as GM's EV-, a car meeting two-thirds of driving needs but has not enjoyed commercial success. Governmental mandates for Green vehicles have run past their original deadline dates.

Rocky Mountain Institute's founder, Amory Lovins, started developing his green car concept also in the 1960's. His concept, called a *Hypercar,* would be constructed of Kevlar. The vehicle would weigh about half of the current standard car. According to Lovins, about 85 % of the fuel is used to overcome inertia and start the wheels turning. When they move, he says 98% of what they move is three thousand pounds of steel and just 1% going to move passengers

A second article in the Journal entitled **CAR TALK** has a series of observations on the car by environmentalists. Charles Komanoff believe that what is at stake is nothing less than the world's climate. Allen Hershkowitz of the National Resource Defense Council believes that nothing is a deleterious to the planet as the present car. Amory Lovins discusses his HYPERCAR that could get 110 miles per gallon. Chris Caldwell, a partner in *ECOS Consulting* proposes an increase on gasoline taxes.

RECENT ARTICLES ABOUT ELECTRIC VEHICLES- Concluded

Battle of Batteries. Business Week, Aug 9 P-22. Car batteries have no sex appeal. The hefty clunker under the hood hasn't changed much since the 1940's. There is a coming battery revolution that will find its way into bicycles, scooters, and cars.

Evercell and Bolder Technologies are perfecting new technologies. The Evercell product is a variation on the nickel-zinc (NiZn) system that was abandoned because on recharge the cells produced dendrites whose sharp points penetrated cell separators. Adding a small amount of calcium to the mix seems to overcome this process. The projected battery life will be 500 cycles.

Bolder is increasing power density by coiling thin sheets of lead into compact cylinders. This increases the active material in the electrochemical reaction and produces a high-power battery with a low internal resistance. Bolder expects soon to test a 5-pound battery that could provide the starting function of a 40-pound conventional lead-acid battery.

FROM OTHER EV NEWSLETTERS

Electric Grand Prix, the New York Group in their September Newsletter describes the new Honda *Insight* hybrid. It uses a 1.0 liter engine and brushless DC motor.

Their October issue notes that Ford soon will deliver its P-2000 hybrid for EPA testing. This is a lightweight car built out of aluminum that is only 60% the weight of a Taurus.

The EEVC September Newsletter from the Eastern Group in Valley Forge featured a report on their annual *Duryea Days* event. Exhibited were a 1919 Detroit electric, a 1915 CT bus, and members cars tat included an Escort and toy Jeep.

VEVA, the Vancouver group, in their September Newsletter describes the *Might-E* mid-sized work truck with a half-ton carrying capacity. It was designed and built by member Randy Holmquist. Curb weight is 3500 pounds.
They also have a report from the Woodburn, OR dragrace event in August. The most-interesting dragster was the 6-wheel, 6-motor dragster called the *Megawatt Monster*. The six motors were coupled to a single 2" diameter shaft. When the driver hit the throttle there was a sound of the motors revving freely as the tranny let go under the awesome torque.

A dual GE-powered dragster, the Cloud, broke fairly spectacularly on its first run with motors missing brushes and holders and a particularly ugly commutator. There was also a cracked gear and broken chain sitting on one of the tires. The KTA Services *Circuit Breaker* dragster logged the best time at the meet - 10.66 seconds. Rod Wilde's *Mazda Maniac* made a spectacular start with the front wheels going ~~skyborn~~ skyward at launch. There was major font-end damage.

FROM OTHER EV NEWSLETTERS - Concluded

EV Circuit from the Ottawa Group in their July/August Newsletter noted that member Rick Lane, attired in suitable appropriate costume, exhibited their 1915 Milburn Electric at the Antique Auto Club of Ottawa.

They also note that long-time member Fred Green is starting conversion of a 1985 Jetta with automatic transmission and power steering. Member Richard Hatherhill has started working on his year 2000 project, conversion of a 1989 Honda CRX.

FVEAA member Jerry Mitchell was also the subject of an Errol Wallingford article on *Pulse Charging for extending EV Range.* Jerry has been experimenting with the technique. He reports that a PULSE TECH charger improved the range on one of his EV's with a 48-volt system from 14.7 to 25 7 miles. The batteries would start to gas at 55.6 volts with a conventional charger but started to taper at 55 volts with the PULSE.

All chargers work off an AC source. Rectifying the AC produces pulsed DC, along with a lot of electrical"hash". Errol ran a series of tests on his 144-volt Geo Metro. In the winter, the maximum usable energy from conventional charging was a low 2.4 kwh. With essentially the same charging level, his homemade, unfiltered pulse charger with automatic termination at 172 volts. The usable energy increased to 3.2 kwh after a few cycles.

They report the Delphi, GM's parts-maker, anticipates a general move toward voltages higher than the present 12 volts in future cars. A Renault was exhibited at an auto show with a dual 42/14 volt system. Output is generated at 42 volts with an dc-dc converter also providing 14 volts. The electric power steering operated at 42 volts. A conventional 12-volt starter was retained.

Tripling the system voltage implies 42-volt devices could be one-third the linear dimensions and one-ninth the weight of their 14-volt counterparts. The next stage of development could be a 42-volt brake-by-wire system and electrically-actuated valves.

PUTTING PERFORMANCE IN YOUR ELECTRIC CAR - Part II

REVIEW

In *PART I* the effects of car Weight, Road Load, Aerodynamic Drag, Hill Climbing, and Acceleration were discussed. The importance of starting torque was also mentioned. In *PART II* these factors will be applied to calculate the performance of a conversion vehicle.

THE BATTERY PACK

The first item to consider is the battery pack. The typical weight and available battery space will usually accommodate twelve individual type GC-2, deep-discharge batteries. Using 8-volt GC-2 batteries connected in series will provide a 96-volt (nominal) system used for the reference car. The total weight of the batteries and racks is 850 pounds. Batteries usually make up 25 % of the vehicle curb weight so the curb weight of the reference car becomes 3200 pounds..

CONTROLLER

Commercially-available controllers have a short-time peak current rating for acceleration of 400 amps. At 400 amps there is a 1.5 volt drop in each battery and wiring, a total of 18 volts for the pack. The terminal voltage at the controller is a nominal 78 volts. The battery-controller combination will deliver a maximum power of

$$(96\text{-}18)(400) = (78)(400) = 32 \text{ kilowatts (kw) to the controller.}$$

There is another 0.3 volt drop @ 100 amps in a Curtis 1231C-7701 controller. It rapidly rises as current draw increases to maximum. The net result of battery and controller voltage drops will reduce the delivered power to the transmission to about 30 kw.

REFERENCE CAR

The owner wishes to have his converted car to have a top speed of 60 mph. This is an arbitrary decision and a matter of battery voltage, motor selection, and gearing of the drive train.

Another arbitrary decision is acceleration. It also depends on the same factors as top speed. For illustrative purposes, a 0-30 mph (44 feet/second) in 5 seconds will be used. This will be close to the 30 kw peak power available as previously calculated..

Acceleration Calculations:

Acceleration is an important characteristic in performance. We will begin by calculating factors affecting acceleration, using Newton's Laws of Motion:

Distance = (0.5) (Time)(Final velocity) = (0.5)(5 seconds)(44 feet/sec) = 110 feet
(60 mph = 88 feet per second)

Average acceleration = 8.8 feet/sec-sec

Accelerating force required: F= (mass)(acceleration) = (car weight/g)(average acceleration)
(g = acceleration of gravity)

$$= \frac{(3200 \text{ pounds})(8.8 \text{ feet per sec-sec})}{32 \text{ feet per sec-sec})} = 880 \text{ pounds}$$

Power level required for the specified acceleration:
The 880 pounds of force is applied for 5 seconds over a distance of 110 feet:

$$\text{Power} = \frac{(\text{Force})(\text{Distance})}{\text{Time}} = \frac{(880 \text{ pounds})(110 \text{ feet})}{5 \text{ seconds}} = \frac{19360 \text{ foot-pounds}}{\text{second}}$$

Since one horsepower = 550 foot-pounds per second, the power calculated above can be stated:
Power = 19360 foot-pounds/second divided by 550 = 35.2 horsepower

Also, one horsepower equals 746 watts so Power = (35.2)(0.746) = 26 kw.

Relevant factors for the reference car are summarized in the following table:

Item	Value Used
Vehicle curb weight in pounds	3200
Top speed in miles per hour	60
Acceleration 0-30 mph in Seconds	5
Distance traveled in feet	110
Average acceleration in feet per sec-sec	8.8
Acceleration force in pounds	880
Power in kw	26
System Voltage	96
Number of batteries (8-volt)	12
Battery Weight in pounds (Including battery racks)	850
Power in kw	26
Road Load in kw	5.76
Aerodynamic Drag in kw @ 60 mph	17.24
@ 30 mph	4.59
Climbing a 30 degree incline in kw	48

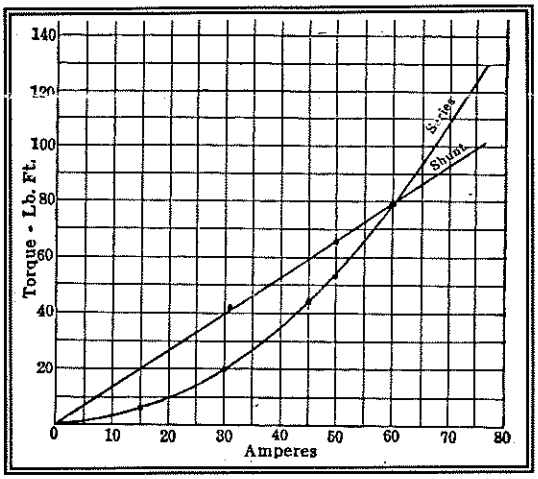
At a constant 60 mph the power required equals 5.76 + 17.24 = 23 kw. At a constant 30 mph the power required drops to 4.59 + 5.76 = 10.35 kw. The greatest power requirement is hill-climbing, 48 kw for a 30-degree slope. A transmission is required to deliver required torque for acceleration, hill climbing, and other situations where the torque required exceeds the maximum available from the motor shaft.

GEARS AND MOTORS

All gasoline engine cars have transmissions. The engine develops maximum torque at 4-5000 rpm. The transmission allows maximum torque to be applied from standstill. An electric motor has different torque characteristics than an engine but the transmission is still useful..

There are two principal types of direct-current motors, shunt-wound and series-wound. The torque of a shunt-wound motor increases linearly with current but in a series-wound motor it increases geometrically as the illustration shows.

Early conversions used surplus shunt-wound motors. Today, series wound motors more suitable for electric vehicle conversions are commercially available and preferred. AC motors have the best torque characteristics but are seldom used by individuals or their projects due to the high costs of obtaining AC from a battery source.



Torque-current characteristics of DC motors

TORQUE

The first sentence of PART I states " Starting torque sells cars." First gear in a transmission will multiply the accelerating torque. Applied to my Mazda RX-7, a 3000-lb conversion that retains the five-speed gearshift, the car achieves 0-30 in five seconds by starting in second gear. For cruising on urban streets at 30 mph I stay in either third or fourth gear. First gear is used only for fast acceleration from a red light or on hills. Fifth gear is not used since I have driven the car 61 mph in fourth gear.

USEFUL PERFORMANCE FACTORS

There are useful factors that can be used to compare performance. The following are from the November , 1999 issue of *Car & Driver:*

Car Mfg - Type	Type	Power - bhp @ rpm	Torque - lb-ft @ rpm	Weight lb	bhp/ Weight
Volvo V-40	Wagon	160 @ 5100	170 @ 1800	3065	0.052
GMC Yukon	SUV	285 @ 5200	325 @ 4000	5467	0.052
Pontiac Bonnevl	Sedan	240 @ 5200	280 @ 3600	3852	0.062
Lincoln LS	Sedan	210 @ 6500	205 @ 4750	3642	0.057

The power listed in the table are in terms of *BRAKE HORSEPOWER (bhp)*. This unit is derived from the way steam boilers are rated. The usual definition for one horsepower is defined as the power delivered by an agent while doing work at the rate of 33,000 foot-pouinds per minute or 550 ft-lbs per second. A horse exerting a 100-pound pull on a wagon walking at the rate of 5.5 feet per second has a one horsepower output. Remember that a confusion of units by NASA caused the Mars space probe to crash. When comparing an eletric motor and gasoline engine, stick with kilowatts (power) and kilowatt-hours (energy) as consistent units..

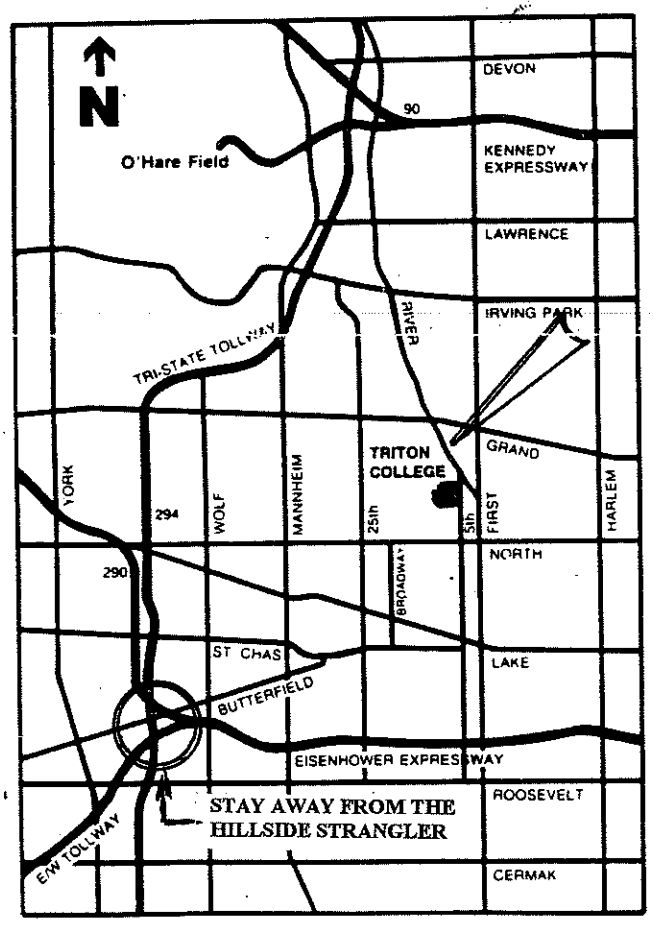
Note also the narrow range of the power/weight ratio in the table above.

NEXT MONTH

PART III of this series will deal with the standard driving cycle for electric vehicles. The urban driving standard developed by the Society of Automotive Engineers defines a 100 second driving cycle that peaks at 45 mph. Also covered will be data on the magnitude of various energy losses we will begin an examination of the second big question usually asked, "How far can it go?"

William H. Shafer
October 1, 1999

GETTING TO TRITON COLLEGE, OUR NEW MEETING LOCATION



From the south on I-294 (Tollway) Exit the northbound lane at Roosevelt Road. **(AVOID THE HILLISDE STRANGLER EXIT TO THE EISENHOWER)** Drive east 4 1/2 miles and then turn north on First Avenue at the Hines Hospital corner. Drive north on First to North Avenue and make a left turn to North to the first traffic signal and drive west (Fifth Avenue). Turn north on Fifith Avenue to the first traffic signal where you can enter the west campus of Triton. (Left-hand lane)

From the north on I 294. Exit eastboud on Irving Park Road. Eastbound on Irving to to River Road where you will turn right to the Triton entrance.

From the west on North Avenue. Turn left at Fifth Avenue just past the shopping plaza. (See above).

From the east on North Avenue. Turn north at Fifth Avenue (Five blocks west of First just after the underpass. (See above).

THE TRITON CAMPUS AND OUR NEW MEETING LOCATION

Triton College is located in River Grove. The map on the preceding page shows how to get to the place. The map below shows the route after you make the turn off Fifth Avenue.

You should be in the left lane when making your turn west from Fifth Avenue to the campus.. There is a double left-turn lane and you should be in the left when you are on Fifth.

Our meeting room is in Business Building (Building B) The closest parking is in the student lot west of Building B. Our assigned room is B-200. Triton has an active evening program. Don't be surprised if here are lots of cars in the student lot. There are handicapped parking spaces just west of Building B and parking is enforced. The building has elevators serving the upper floors.

We are pleased to be associated with Triton College. They have an excellent automotive technology program and believe both the FVEAA and Triton can benefit by adding an active program involving electric cars.