Electric Auto Association

CURRENT EVENTS

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RUNNING ON EMPTY

By Michael Gougis

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It was a moment of severe cognitive dissonance for Lisa Rosen. The Seal Beach probation officer sat in the basement meeting room of a state office building in Sacramento. The room was packed. For hours, she listened to the world's biggest automakers beg clean-air regulators to kill off a state requirement to put emission-free cars and trucks on California's roads.

The party line, parroted by representatives of General Motors, Ford, Honda, Toyota, and other automakers, was that electric-powered vehicles, the only type that can meet the zero-tailpipe-emissions mandate right now, just don't cut it. Their batteries are too expensive, they don't go far or fast enough, they're too small, no one will buy them. Detroit has raised the same objections to battery-powered vehicles for decades. "Electric cars with broad consumer appeal are an idea whose time has come and gone, much like eight-track tapes, Betamax, and New Coke," said Jo Cooper, president of an industry lobbying group that represents the builders of nine of every 10 cars sold in the United States.

Rosen just shook her head. Her reality clashed sharply with the verbal pictures being painted in the hearing room. Three times in recent months, she had driven a sprightly little GM electric car, known as an EV1, to Sacramento to speak in defense of electric vehicles. In other words, she had driven a car that auto manufacturers said they couldn't afford to make on a trip they said the car couldn't take. She and her family, by no means wealthy, had to fight like hell to get their hands on their EV1, a sleek, rapid two-seater that still turns heads in auto-jaded Los Angeles.

Her car had never left her stranded on her 31-mile commute to work, never left her searching for a place to recharge. Her family loved the thing so much they quickly divested themselves of all but one gasoline-powered car, and that one, a Toyota, usually sits unused in their driveway. When she and her husband, Douglas Korthof, head for Santa Barbara or San Diego, they grab the EV1. The car has an "I * New York" sticker in the rear window that it actually earned; their son had driven it from Southern California to Montreal and then decided to swing through Times Square.

"Once you get out of the habit of going to gas stations, you don't miss it at all," she says. "But driving electric cars is a direct challenge to the auto industry and the oil industry. They hate us."

Perhaps the Big Three were secretly influenced by the rebellious ideology of Nation of Islam leader Malcolm X, because "by any means necessary" certainly describes Detroit's efforts to undermine and destroy CARB's groundbreaking zero-emissions-vehicle mandate. With high-powered lobbyists and environment-friendly-sounding "grass-roots" organizations that were simply industry-funded shills, with legal attacks and half-hearted technological efforts (save General Motors — the EV1 is widely considered an engineering gem), the auto industry — frequently joined by its oil-refining brethren — has missed few opportunities to chip away at the mandate. When CARB first passed the zero-emissions rule, GM alone would have had to put more than 6,500 electric cars on the road by 1998. To date, only about 5,000 such vehicles have been sold or leased in California by all manufacturers.

Direct challenge is a good way to describe the interaction between state regulators determined to clean up the nation's worst air pollution and the companies that were supposed to build the cars to make that possible. When the California Air Resources Board (CARB) voted way back in 1990 to require automakers to put zero-emissions vehicles in their showrooms within eight years, Detroit went along with the plan, admittedly a bit hesitantly, almost like someone going on a blind date. But within three years, with the nation's economy slumping enough to cost Bush Senior a second term at 1600 Pennsylvania Avenue, and the ass-whupping Detroit had taken at the hands of Japanese automakers still fresh in its memory, the relationship had deteriorated to the point of open hostility.

The electricity crisis has provided automakers with yet another opportunity to

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What categories did the Auto Manufacturers fit into?

Small volume manufacturers are defined as those with California sales below 4,500 per year, using the average number of vehicles sold over the preceding three years. Small volume manufacturers are not subject to the ZEV requirement.

Dae Woo	Ferrari	GFI
Lamborghini	Lotus	Porsche
Rolls Royce	Saab	Suzuki

Intermediate volume manufacturers are defined as those with California sales between 4,501 and 35,000 light and medium duty vehicles per year, again averaged over the preceding three years.

BMW	Subaru	Hyundai
Isuzu	Jaguar	Kia
Mazda	Mitsubishi	Rover
Volkswagen	Volvo	

Large volume manufacturers are defined as those remaining manufacturers.

DaimlerChrysler	Ford	GM
Honda	Nissan	Toyota

During public comment at the March workshop, one manufacturer recommended that the minimum annual sales threshold for a large manufacturer be increased above the current level of 35,000. This manufacturer noted that automakers just above this cutoff are far more limited in resources than the existing large manufacturers, who typically have annual California sales of at least 100,000 and often substantially more. Another manufacturer made a similar recommendation, with similar reasoning, regarding the minimum annual sales threshold for an intermediate volume manufacturer, currently set at 4,500. Representatives of several intermediate volume manufacturers testified that due to constraints imposed by the planned dates for introduction of new engines and vehicle platforms, they would not be able to produce the required number of PZEVs as early as 2003.

BMW and Volkswagen have each been selling approximately 35,000 vehicles per year in California in recent years. If their 2000 through 2002 MY average sales exceed 35,000, they will need to meet ZEV requirements as large volume manufacturers beginning in MY 2006.

Subaru, which is currently considered an intermediate volume manufacturer, has been selling near the lower limit of the intermediate volume manufacturer classification in California in recent years. Therefore, depending on its actual sales in model years 2000 through 2002, Subaru may be classified as either an intermediate or a small volume manufacturer in MY 2003.

In 1998 Isuzu produced only light duty trucks between 3,751 and 5,750 pounds gross vehicle weight (LDT2s), which are not subject to the ZEV requirement. Rover produced only medium duty vehicles, also not subject to the ZEV requirement. Therefore, although Isuzu and Rover are intermediate volume manufacturers, they will not need to produce any ZEVs in MY 2003 if they continue to produce only LDT2 and medium duty vehicles.

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Reasons to drive an EV1

By Steve Kirsch

Hi. My name is Steve Kirsch. I'm a successful computer entrepreneur. In May 1998, I became one of the first owners of an EV1 in Northern California. Forget what you think about what an electric car must be like. Let me tell you what it is really like…

First, the EV1 is an amazing feat of engineering. It is the first and only fully electric production car built in the world in the last 50 years (check this?).

Like to accelerate fast? This car is fast. It's so fast, it's easy to burn rubber in this car if you are not careful.

Like to race? You'll love this car because you'll always win… by a mile. In 2 seconds, you'll be seeing your competition in your rear view mirror. The reason is simple: this car has full torque at 0 rpm. And there is no shifting to slow you down either. This car can literally go from 0 to 180 mph in first gear. But don't get too excited… the one you'll buy at your Saturn dealer has a limiter on it so you can only go around 80 mph. But that's not so bad. You save money on those speeding tickets you won't get. And it keeps you from traveling at a dangerous speed and possibly killing yourself.

The biggest downside is that the car goes around 130 miles between recharges. A full recharge takes 5 hours.

I've found this is perfectly adequate for my commuting needs. I can go from home to office and back for a week without recharging. While you can't get rid of your gas guzzler entirely, for most times, you'll find yourself choosing to drive your electric car. Once a month, I run the gas car to keep the parts lubricated.

It's quiet. Not totally silent (we also own an electric Toyota RAV4... it's the quietest EV on the planet and it's nearly silent). There's a bit of a whir sound. My kids think it sounds a bit like a spaceship. Looks like one too, from the shape of it. And the center dash with all the controls is futuristic looking too. Very cool.

It's slick. Aerodynamically, it's the slickest car ever produced. Lower wind drag means more mileage.

You'll never need gas or oil. No more smell or mess. Or wait for an oil change. This car is as maintenance free as it gets. You should rotate the tires every 5,000 miles. That's about it. You'll never need to steam clean your engine again (well, not that you do anyway). Everything is as clean under the hood as the day you bought the car. Ever run out of gas? Not with this car. You can never run out of gas since there isn't any. And you can "fill 'er up" anywhere! Literally, you can plug in the portable charger (that stows in the trunk) anywhere there is an electrical outlet. It's like having a gas pump on every street corner.

Not enough trunk space? This car has great trunk space.

Ever drive off with the parking brake still set? Never again. This car is smart enough to release the parking brake when you shift into gear. And to automatically set it when

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Daimler-Chrysler EPIC 5-passenger minivan. Fleet/Commercial Customers only. NiMH batteries gives it 70-80 mile range. Built and placed about 180 vehicles.

Ford EV Ranger 2-passenger truck. Fleet/Commercial Customers only. NiMH batteries gives it 60-80 mile range. Built and placed about 400 vehicles.

Memoranda of Agreement

ZEVs are a key element of California's plan for reducing air pollution caused by automobiles. ARB is committed to the successful introduction of ZEVs and is taking steps to ensure the market is ready.

Background:

1990:
In 1990, ARB adopted the Low-Emission Vehicle and Clean Fuels regulations. These regulations included a requirement that the seven largest auto manufacturers produce the following percentages of ZEVs.

- 1998 - 2% ZEV requirement;
- 2001 & 2002 - 5% ZEV requirement
- 2003 and beyond - 10% ZEV requirement

1996:
In March 1996, the ZEV program was modified to encourage a market-based introduction of ZEVs in California in the near-term and to promote advances in electric vehicle battery technology. The 10 percent ZEVs in 2003 and beyond remains in place.

Memoranda of Agreement (MOA):
In order to establish a program which allows vehicle introductions to be voluntary, but requires continued investment in battery and vehicle development, demonstration, and commercialization, the ARB entered into a separate memorandum of agreement (MOA) with each of the seven largest auto manufacturers - Chrysler, Ford, General Motors, Honda, Mazda, Nissan and Toyota. Each MOA represents a cooperative agreement between the auto manufacturer and the ARB and commits both parties to tasks designed to ensure the successful launch and long-term success of the ZEV program.

Principle Elements of the MOA:
The seven largest auto makers agreed to:

- offset the emission benefits lost due to the elimination of the ZEV requirements in model years 1998 to 2002 by opting-in to the National Low-Emission Vehicle program beginning in 2001, three years earlier than could be required under federal law;
- continue investing in ZEV and battery research and development and to place up to 3,750 advanced battery-powered ZEVs in 1998, 1999, and 2000;
- participate in a market-based ZEV launch by offering ZEVs to consumers in accordance with market demand;
- provide annual and biennial reporting requirements.
- The ARB has committed to:
- facilitate the purchase of ZEVs in state fleets;
- work with other state agencies, local governments and private industry to address various infrastructure issues;
- continue to work with emergency response officials to create a comprehensive emergency response training program; and
- support reasonable incentive programs.

Enforcement:
The ARB will conduct biennial reviews of the ZEV program. The most recent biennial review took place July 30, 1998. A manufacturer that fails to comply with the requirements of the MOA will be subject to fines and could be subject to the reinstatement of the ZEV requirements prior to 2003.

Benefits of the MOA:

- Market-based ZEV launch which is consistent with manufacturers' product introduction plans and estimates of market acceptance — production commitments already made for four models
- Continued progress and investment in critical technology
- Cooperative effort on implementation issues
- Reporting requirements to keep the process "honest"
- Strong enforcement features
- No loss in emission benefits
- Percentage production requirement retained for 2003 and beyond
- Increased assurance of long-term success of ZEV program

ARB Maintains Drive to Zero Emissions

Sept 8 2000 - The California Air Resources Board (ARB) Friday held fast to its mandate requiring automakers to market thousands of zero emission vehicles (ZEVs) in the state starting in 2003.

ARB Chairman Dr. Alan Lloyd said, "We have to think not just of 2003 but also of protecting the state's air quality far into the future." He said California could lose the battle against air pollution unless its motor vehicle fleet moves toward zero emissions.

The 11-member Board, after listening to testimony Thursday and Friday, unanimously decided to keep the ZEV mandate in place.

Currently, there are about 2,300 electric vehicles on the road in California as part of a demonstration fleet of ZEVs the automakers were required to produce prior to 2003. Automakers satisfied their demonstration fleet requirements and then stopped making ZEVs.

A number of technological innovations have resulted from the ZEV mandate. Automo-

General Motors EV1 2-passenger car. Retail Customers only. PbA batteries - 70-90 miles range, NiMH batteries - 125-150 mile range. Built and placed over 1,000 vehicles.

Chevrolet S10 Electric 2-passenger truck. Fleet/Commercial Customers only. NiMH batteries gives it 60-70 mile range. Built and placed 200 about vehicles.

Honda EVplus 4-passenger minivan. Retail Customers only. NiMH batteries gives it 80-100 mile range. Built and placed about 300 vehicles.

Toyota RAV4 EV 5-passenger sports utility. Fleet/Commercial Customers only. NiMH batteries gives it 80-100 mile range. Built and placed about 450 vehicles.

tive breakthroughs such as hybrid and fuel cell vehicles, and cars free of evaporative emissions are now realities as a result of efforts to meet ZEV requirements. ZEVs have won over a large number of supporters who like the quiet ride and efficient operation of zero emission vehicles.

In addition to eliminating tailpipe and evaporative emissions, ZEVs also reduce greenhouse gases and toxic emissions. Dependence on petroleum products and the emissions associated with drilling, refining and transporting those fuels are also reduced with ZEV technology.

The ZEV mandate is an important air pollution control tool since more than half of the state's smog-forming pollutants come from motor vehicles. California is required by the federal government to reduce air pollutants or face federal sanctions. The ARB received about 75,000 letters in support of maintaining the ZEV mandate.

While automakers claim there is little demand for ZEVs, the ARB hearing drew testimony from many consumers who said they were turned away when they went to auto dealerships and tried to get ZEVs.

While upholding the ZEV mandate, the Board expressed concern at several issues:

- Current lack of ZEV availability.
- Market demand.
- Cost and incentives.

Staff was directed to review the regulation and propose appropriate modifications to address these issues and assure successful penetration of ZEVs into the market.

"Even the cleanest internal combustion engine will pollute more as it ages," Dr. Lloyd said. "California needs ZEVs to help offset emissions from the growing number of vehicles on our roads and rising number of miles they are driven each year," he added.

The ZEV mandate was first adopted in 1990. It was modified in 1996 and again in 1998 to provide additional flexibility to automobile manufacturers and to accommodate the growing number of zero and near-zero emission technologies.

ARB Holds to ZEV Mandate

Jan 26 2001- California is holding firm to its zero emission vehicle (ZEV) mandate, directing automakers to produce between 4,450 and 15,450 electric cars starting in 2003.

The California Environmental Protection Agency's Air Resources Board (ARB) Thursday night voted to keep the 10-year-old ZEV Mandate in place, while making modifications giving automakers additional options in meeting their ZEV requirements.

"This action keeps us steadily moving along the road to an ever-increasing number of zero emission vehicles," said ARB Chairman Dr. Alan Lloyd. "We envision a future where consumers have an expanded range of clean-car choices when they shop for an automobile," he added.

The modifications enacted Thursday require automakers to begin putting new ZEVs on California roads by 2003. The number of ZEVs in 2003 can vary from 4,450 to 15,450, depending on the type of ZEVs the individual automakers chose to bring to market. Meanwhile, the Board's action also requires about 100,000 other highly clean vehicles in 2003 with this number increasing to more than 400,000 by 2006.

The Board also decided to begin in 2007 including heavier sport utility vehicles, pickup trucks and vans in the sales figures used to calculate the number of ZEVs each automaker is required to sell in California. This will increase the number of vehicles used to calculate ZEV requirements from just under 1 million to more than 1.5 million. "More SUV sales will mean more ZEV sales," Dr. Lloyd said.

The ARB's Thursday night meeting saw a major automaker for the first time voice acceptance of the ZEV Mandate. A spokesman for Ford addressed the Board, saying the automaker is prepared to fulfill its share of the ZEV requirement in 2003.

ARB's ZEV mandate is meeting its goal of spurring automakers to develop not just battery-powered electric vehicles but also other new clean-car technologies, including fuel cell vehicles, electric-gasoline hybrids and superclean gasoline vehicles.

Dr. Lloyd pointed out that automakers get incentives for introducing ZEVs prior to 2003. "We could start seeing new electric vehicles on California's roads as soon as next year," the ARB Chairman said.

More information available in the Staff Report for the 2000 ZEV Biennial Review - August 7, 2000
(Includes the Executive Summary)

Microsoft Word - 667K
/msprog/zevprog/2000review/staffreportfinal.doc

or

PDF - 513K
/msprog/zevprog/2000review/staffreportfinal.pdf

Nissan Altra 4-passenger minivan. Fleet/Commercial Customers only. NiMH batteries gives it 80-100 mile range. Built and placed about 80 vehicles.

Other manufactured vehicles have been built but not impacted by this program. Mostly for sale. Included are the Corbin Sparrow and the Solectria Force.

you shift into park. This car has a new way to brake. On the shift lever, you can press a button that slows you down by turning the engine into an electric generator. So you charge your batteries as you slow down. Use this properly and you can extend your driving range by an extra few miles.

Ever lose you keys? Lock your keys in your car? It'll never happen with this car. There are no keys to enter or start the car. Everything is by code. You just punch in a code to unlock the door, and a code (could be the same code) to "enable" the car. Then press the run button, shift into gear, and drive away. Ever had your car stolen? Can't happen with this car. Now I will admit that while in theory, your EV1 could be stolen, it's hard to imagine this happening. First of all, there is no market for the parts. Second is that you'd need to know the right code to turn on the car. And lastly, even if they crack your code and start the car, they won't be able to get very far.

This car has been super reliable. I've only had one problem with it, and it wasn't with the car. It was with the charger. The cord didn't retract properly. I called Saturn and within 1 hour, they had dispatched someone to fix the problem. No charge. And they came to me. In 1 hour. Is that incredible service or what?

Like to have fun? You can have a lot of fun in this car you can't do in any other car. For laughs, my wife and pull into the "full service" bay at gas stations and ask the attendant to "fill 'er up." We crack up as the attendant tries to find the gas tank. When he finally asks where it is, we nonchalantly reply "it's on the left of the car" and let him take another crack at it. Eventually, the attendant asks "hey, what kind of car is this anyway?" When we tell him, we are promptly told to "get out of here." As the EV1 becomes better known, this gag is going to be tougher to pull, so if you want to do this, you should get your car now!

Like to be safe? The EV1 and all EVs have to pass the sme safety standards and crash testing as all other cars (the FMVSS, or Federal Motor Vehicle Safety Standards). In fact an independent testing lab said that EVs are probably safer than gasoline cars because they are not carrying a lot of flammable liquid (gasoline), and have a lower center of gravity to prevent flipping over (i.e. battery weight lower in the vehicle). Most other hazards deemed equal.

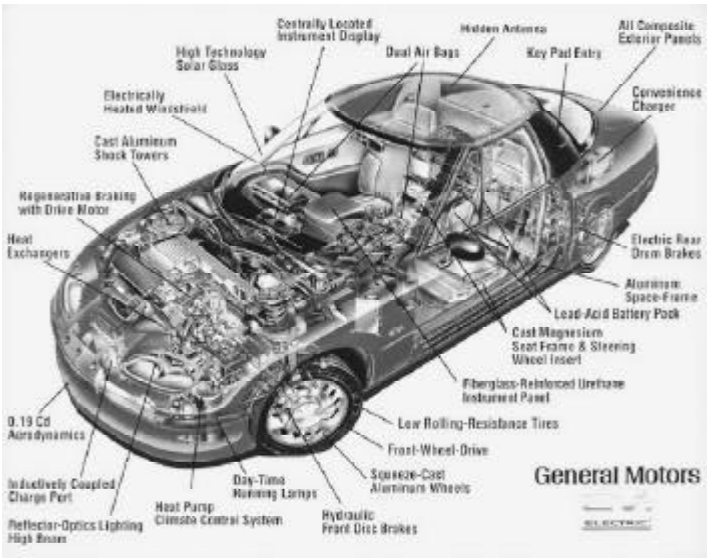
Ever wonder what things you can do personally to contribute to cleaning up the environment? This could be the one thing that you do. Even when you consider the environmental impact of generating the electricity used by this car, the car is still the cleanest automobile you can drive by a long shot. And it is a lot cheaper to not pollute the environment in the first place than to donate money to clean it up!

You'll feel good driving this car, knowing that you are doing the right thing for our environment to preserve it for future generations, like your kids. And you'll have fun driving it. Sure for longer trips you'll want to keep around that old gas guzzler. But for everyday use, this is the car you're going to want to drive.

EV1 with NiMH Battery. Extraordinary, fabulous
by Don Devlin

Only last week, in response to a persons request for advice on driving from LAX to Thousand Oaks, I added my comment along with others, that he should count on no more than 40 miles per charge IN CITY driving. Every person I know who drives primarily in Los Angeles city has said roughly the same thing 40-45. around 3 1/2 to 4 miles per bar. With the many unresolved problems dealing with public charging I was finding it harder and harder to recommend the EV1 to friends, relatives and strangers who would use the car primarily in the city.

That's all over!



Constance and I began testing a new EV1 with NiMH on Thursday. We determined not to attempt to get maximum range, but rather to try and duplicate the same CITY ONLY driving that we did on most days. This proved difficult as we ran out of both patience and City. In traffic, over hills It was absolutely amazing, awesome.

THURSDAY IN CITY ONLY Devlin/ Chesnut
Lead acids: (historical)
3-1/2 to 4 miles per bar.
38 to 44 miles per charge
NiMH batteries:
(96% start charge) 11 miles per bar.
122 miles per charge.
Charging Time:
From 39% to 100% 3 hours exactly.
(39% to 60% in one hour)

The next day we took a trip that we had to make and had never been able to do in the EV1, before. Our trip was to Broad Beach (Trancas) in Northern Malibu (No public chargers) from our home in Hollywood Hills

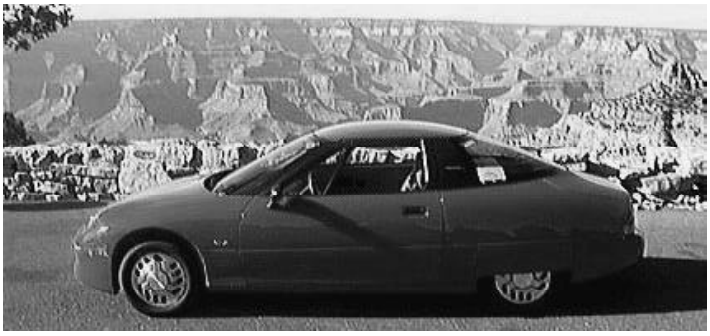
and back again. This would take us through the city to the ocean (PCH) and then up the many rolling hills to Malibu, 37 miles. We passed Malibu Colony (27 miles) as the second bar disappeared drove another ten miles up some serious hills and the third bar disappeared as we arrived at our destination. The way home we took Malibu Canyon which has many ups ands downs through a small mountain range. On to the freeway. Off at Laurel Canyon and over the Mullholland top and down to Hollywood. Back up a steep Hill to our home. We arrived home after 78 miles with 4 bars left.

Again averaging 11 miles per bar.
FRIDAY MIXED DRIVING Devlin / Chesnut
NiMH batteries (100% start charge)
11 miles per bar - 122 miles per charge
Charging time: From 32% to 100% (3 hours and 15 minutes)

All Charging began immediately on inserting paddle. The car felt great and appears to have better rolling abilities. It also seemed to be quieter. Thursday was 85 degrees and so we experienced a rather hot summers day. The air conditioning is incredible. One notch on air conditioning and one notch on fan produced a cold car very quickly. So cold, in fact, we had to turn the air conditioning off or open windows on several occasions.

On flat roads and highways the 99' EV1 with NiMH should routinely get 140 to 180 miles. Its a sensation. We can't wait for our new car.

Huge congratulations to everyone involved. A revolution in Electric vehicle range. Now, for crying out loud, lets tell everyone about it!



Sportscar driving performance
by Marvin Rush

Sadly my test drive of the NiMH EV1 ended. I hated to return it. The car works so well and is so much fun to drive that I really didn't want to give it back. As a last drive I decided to return to Saturn of Alhambra by way of Mt. Wilson.

I live in Sunland which is at about 1700 feet above sea level. I drove to La Canada and turned left on to Angeles Crest Highway. Almost immediately I was overtaken by a Porsche 912, so naturally I decided to glue my bumper to his and off we went. Angeles Crest is a real drivers road. It is fast and curvy. On one side is the mountain and on the other is a several hundred foot drop. Oncoming traffic consists of street racing motorcycles and others driving sports cars very fast. There is a sign on the highway advising how many deaths and injuries have occurred in the recent past. This is a dangerous road. Mistakes are costly!

I don't know how hard the Porsche driver was driving his car. I am sure he wanted to leave me behind.

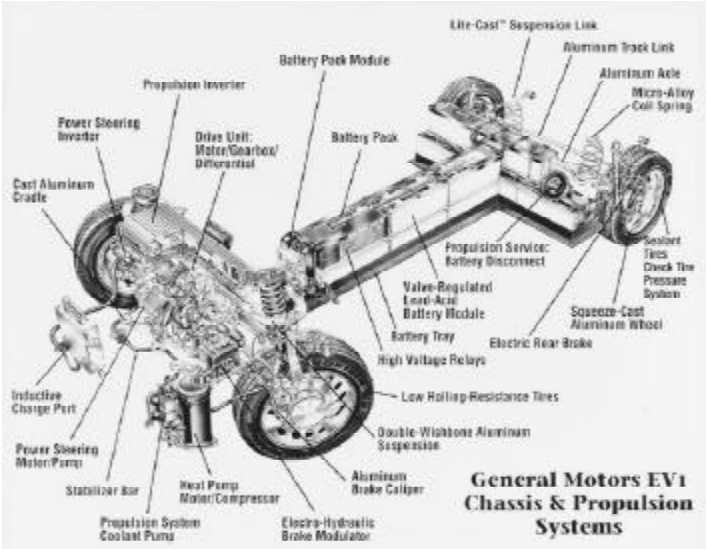
He could not do it!

The improved EV1 with NiMH handles like a true sports car. At the same time it has the power reserve and the acceleration to exploit it's strong suit. It doesn't have as much cornering ability as some cars but it has instant acceleration. This means that in even in a small straightway you can close almost any gap. The Porsche didn't have a chance at loosing me. As the elevation got higher the EV1 performed better and better while the piston engine car was producing less power. This is because, as the air gets thinner the gasoline car makes less horsepower, while the EV1 is unaffected. In fact since the air is thinner there is less wind resistance and therefor less drag. I'm sure at 10,000 feet and above the EV1 is untouchable. (A supercharger on a piston car would even things up however.)

At the top of the mountain I got out and took a look. Below me the entire Southern California Area was visible. From a vantage point just over 5000 feet above sea level you get a sense of just how many internal combustion vehicles we are up against. They and their attendant structures are everywhere. From freeways to parking lots to the cars themselves they cover every square inch of the view.

The good news is that apologies are just about over. This car 'rocks' and can do everything well. Everything including race to the top of a 5000 foot mountain and still have plenty of energy left over to go back down the mountain and drive all over town. At the top I had just over half a tank of energy. When I finally arrived at Saturn of Alhambra I had driven just over 50 miles and the range gauge showed 150 more miles to go. I was at 70% full.

WOW!



EXPERIENCE - COMPARING EV1 AND EVPLUS

by William Korthof

I'll start from 1996...

Since I enjoy bicycling, hiking, and running, the bad air quality in the LA area has direct and negative consequences for me. After decades of pollution reduction programs, California's already clean electric generation mix underscored my view that electric cars are fundamentally more effective at cutting air pollution than iterative efforts to clean up (and maintain) the tailpipes from millions of individual cars.

I've always had an interest in energy and the wastefulness of our auto-based and petroleum-dependant transportation was a nagging irritation. The relatively high efficiency of battery-powered electric cars coupled with the inherent ability to generate electricity from a multitude of sources (including renewables), are compelling reasons for electric vehicles.

By the end of 1996, I had decided to go carfree until I could get an electric model, much to my parent's consternation. I first learned of Honda's electric car back in 1996. I was excited that it would be a 4-seater with newly developed NiMH batteries (for more range) and a built in conductive charger. Compared to the EV1, it seemed like a better offering.

In May of 1997, after my first year away at college, Honda began leasing the EV Plus. Once I saw an ad from the nearest EV Plus dealer (Costa Mesa Honda), I went with my parents to test drive, find the terms, and sign up. We were all impressed by how well the car handled and the entire subtle advantages of a fully developed, factory-built car.

The luxury car-level MSRP coupled with the peculiar lease-only availability were major concerns. However, the lease terms were at least reasonable, particularly the unlimited mileage. Although I planned to be the primary driver and I lived away from my parents, they wanted to go ahead with the lease, and they passed Honda's "screening" criteria.

Right from the start, I was eager to maximize the mileage with the car, literally and figuratively; learning what I could in the process.

The first weekend, I packed jumped in the car with three friends for a long trip to Hollywood and Santa Monica, intent to [safely] test the range in the process.

As I began to figure out recharging arrangements, I made many trips around the LA basin and between my parent's house and my University. On the weekends, my parents often took the car to visit their parents in San Diego County. As I optimized my driving technique, I recorded 1-charge, round-trips of 133 to 143 miles (mostly city streets) a number of times. I soon took trips to the mountains— first Mt Baldy, then Big Bear.

Gradually, as my parents became more confident and familiar with the car and its parameters (range, charging rate), they were eager to drive it more often. The Honda soon became the car of choice for all of us—not just because of it's enviro benefits, but also because of its reliability, home-charging convenience, comfort, and its fun-to-drive, peppy handling.

In May of 1998, ready for a longer trip, I met enthusiastic EV1 driver Greg Hanssen for a trip out to Las Vegas in our two electric cars. We thought the trip might allow us to compare the vehicles and better respond to the persistent "what if I want to drive to Las Vegas" question that we (and other) EV drivers were often asked. The trip was spaced around the range of Greg's EV1, and the slower charging speed of the Honda. We made arrangements at a few RV parks and a restaurant spaced on roughly 50-mile intervals over the 280-mile trip. At each stop, we plugged into 240-volt outlets for about 1.5 hours, using the time to eat and talk with the site owners. We arrived in Vegas in a day, and returned in a day. Although we had a few exciting "white knuckle" moments, we completed the trip on time, and without any problems.

A couple weeks later, I took the Honda on a 1-week trip up to the Bay Area and Sacramento with two friends. Again, the EV Plus performed flawlessly on the 1,200-mile sightseeing trip.

By the end of the first year, my parents and I had never been stranded or by the car and we had already run up 25,000 miles. We were jockeying for who would take the car, for a day or a week at a time—"I'll be taking it to an Earth Day event", or "...I'll put on 400 miles commuting to work this week"... "I'm planning to go to Big Bear"... As our total ICE driving dropped and we began planning more trips around the EV Plus, we realized the electric car worked for us not as an ancillary second car, but as our primary vehicle.

My parents (my dad in particular) were soon considering a second electric car. While the EV Plus proved itself, it didn't seem right to have two of the same model in the driveway. I located a Ford Ranger EV dealer, and we tried out the Ranger EV for a few weeks, but it seemed like too much of a challenge. Although we had initially dismissed the 2-seat EV1 as impractical, we decided to take a second look in the summer of 1998. The EV1's powerful acceleration made the car exciting to drive, but limited range from the original batteries aroused concerns, even if the EV1 was to serve as a second car to the Honda. We were also put off by what we felt was half-hearted support for the EV1 by general motors. However, when GM offered a discounted lease for "dealer" models in 9/98 and waived the mileage charges, my parents jumped.

Although the original EV1 presented more challenges and required a longer learning curve for my parents, we fully incorporated it. My mom, a self-described techno-phobe, finally caught the EV bug in earnest when she took the Gen1 EV1 on a trip up to San Francisco.

We were over 50,000 miles on the EV Plus by the end of its second year, and the car was remained completely trouble free. By the end of 1999, we were thinking about going [nearly] all-electric with a third EV, and the prospect of the new Nickel metal hydride EV1 with up to 150 mile range was tantalizing. When we had a "loaner" for one day, I took it to Las Vegas (and back): about 600 miles, proving the 150-mile range, and returning within one day. We were finally able to get the NiMH EV1 in 1/2000.

Alas, with GM's recall/repossession in March, we lost the Gen1 EV1.

By combination of owners, listed at http://www.hondaev.org/ro.html

The Honda EVplus is a purpose-built electric vehicle, not a conversion of an existing gasoline powered car. It is a two-door hatchback, with four seats. The rear seats fold down for increased cargo space. The car is built in the same Japanese plant as the Acura NSX sports car, and the quality of fit and finish on our car is excellent. Honda plans to lease about 400 EVplus cars in California in 1998 in order to evaluate the driving habits and customer lifestyles of potential EV owners. The EVplus is not for sale; it is available only through Honda's 36 month "Charter Lease Program."

How does it drive? The car has all of Honda's tradition of quality, and is well-balanced, safe, a joy to handle, and will hook anyone on electric cars for ever more. Typically, I set people down in it (I'm in the passenger seat), hand them the keys, and they're on their own. Everyone who has driven it is first amazed that you don't have to "start" anything, and then how easy it is to drive, and then at its acceleration and "feel" of power. In traffic jams, regenerative braking and positive speed control virtually eliminate "stop and start" driving. Many people involuntarily exclaim, ***This is the way cars should drive!***

Performance

Range: EPA city driving is 100 miles, highway 84 miles. Our real-world experience shows these numbers to be quite accurate. Acceleration: 0-30 in 4.9 seconds, 0-60 in 17 seconds (the car's performance is optimized for city driving, although freeway performance is also quite good). Top speed: 80+ mph (we've driven ours at 76 mph ... solid, and felt like there was still room to accelerate to pass if we needed).

Drivetrain / Batteries / Charging

Motor: high-efficiency, permanent magnet. Power output: 49kw (approx 66 hp) @ 1700-8500 rpm; torque is 275 Nm (203 lb.-ft... it loves hill climbing!) @ 0-1700 rpm. Batteries: 24 12-volt nickel-metal hydride (NiMH ... no "memory effect"). Transmission: 1 speed, direct drive. Charger: on board (110v or 220v power supply). Recharge time: 6-8 hours (220v from 80% discharge). Honda required EVplus owners to install a 220v regulated/isolated power supply in their garage for charging the vehicle (our installation cost was $1905.00).

Chassis / Suspension

Front wheel drive, unit-body construction w/integrated large cross-section straight frame rail. Front strut / rear beam suspension. Electric, variable power-assist rack and pinion steering. Grade-sensitive regenerative braking with ABS (regeneration allows you to "recapture" expended power on downhill runs by using the motor as a generator, thus extending the car's effective range). 14" alloy wheels with low-rolling resistance 195/65 R14 tires.

Comfort / Convenience

Power windows, door locks, mirrors, with automatic climate control for heating and cooling (the car has a "heat-pump" style climate system). AM/FM/CD; multi-function remote (you can "precondition" the cabin temperature or read how charged the batteries are from the remote!) with keyless entry to arm/disarm the security system. Heat-reflecting glass. A friendly walk-in feature for rear seat access (and a flat floor to increase rear seat legroom), with split-folding rear seatbacks.

Safety / Security

Dual airbags with 3-point belts at all seating positions. Theft-deterrent system. Underfloor battery pack layout is protected by frame rails. Isolated electric-power control systems. Intelligent crash-detection system disconnects all propulsion power. Energy-saving high-performance gas-discharge headlights.

Exterior / Interior Dimensions

Wheelbase: 99.6 inches. Length: 159.3 inches. Height: 64.2 inches. Width: 68.9 inches. Track (f/r): 59.1/58.7. Curb weight: 3,590 lbs. Headroom (f/r): 39.7/38.2 inches. Legroom (f/r): 41.9/34.2 inches (yes, you're reading that rear legroom correctly!). Shoulder room (f/r): 53.2/51.9 inches. Hip-room (f/r): 48.6/46.9 inches. Cargo space: 11.5 cu ft. Interior passenger volume: 89.1 cu ft. Carrying capacity: 700 lbs. (passengers and cargo combined).

Lease Terms / Purchase

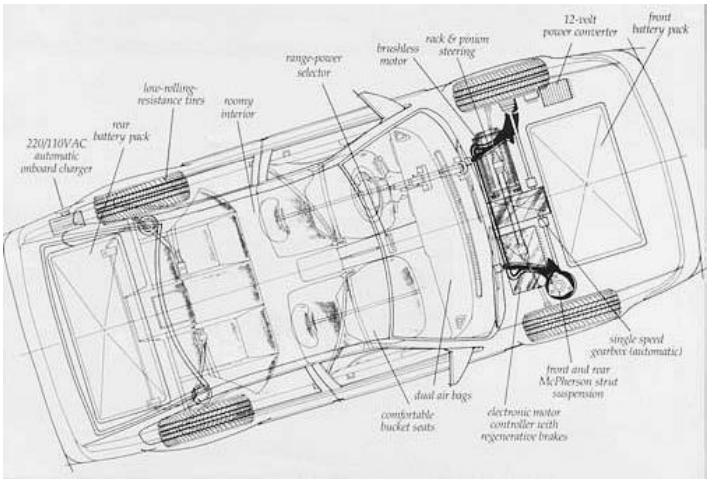
The Charter Lease Program is a 36-month, all-inclusive lease. The lease includes all maintenance, 24/7 roadside assistance, collision and comprehensive insurance (the lessee must provide liability insurance only), and use of a loaner if the car is kept for service. The Northern California lease price is currently $454/month (plus tax), and there is no buy-out option at the end of the lease. The car carried a sticker price of $53,999, although you cannot purchase the car. The car is eligible for $4,000 in federal tax credits, and $5,000 in California and Bay Area tax incentives (Honda uses this $9,000 to reduce the lease price to $454/month).

[Note that existing leasees have an opportunity to extend their lease 12- to 24-months after the 36-month lease expires. The lease price is reduced to $300/month (plus tax), but additional conditions apply, such as repairs greater than $4,000, which cause early termination of lease. No leases are extended beyond Dec 2002 which is the end of Honda's EV lease program.]

by Will Beckett

Solectria is a small company located in Torrington MA. Their primary business is electric vehicle components but from the early years they have offered electric vehicles for sale. The Sunrise is a purpose built car they offered for $90K which broke most of the distance records on a single charge. They also had a small utility truck for slow speed applications. The most popular of their vehicles however, was the Solectria Force. This is a Metro (4 door) conversion that started off with belt drive and flooded batteries and later replaced the belt drive with a gearbox and flooded with maintenance free batteries. Lead/acid, NiCad and NiMH batteries were all options for this vehicle.

After driving an S-10 Blazer conversion for six years I found a good deal on a 1999 Solectria Force and jumped on it. The car is not to the level of finish of an EV-Plus, or EV-1 but unlike these cars it was possible to purchases it and it is a door, four-passenger vehicle. This vehicle is 156-volts and has an AC three phase motor. The East Coast version has AC and there is an option for an Avcon charging receptacle. Top speed is around 70mph on a flat road with little wind but speeds under 50 it matched or exceeded that of its gasoline counterpart. This is the car my wife will drive unlike the Blazer. It is small and efficient and manages about 90% of all the family needs.



Solectria has their own controller for managing the pack voltage and AC motor and DC to DC converter for the 12v requirements of the vehicle. Like most electrics, the operation is simple. There is a key for the ignition and once on there is a rotary switch that controls forward and reverse. Safety features built in the car prevent operation unless the switch is in the neutral (off) position first after the key has been turned on. The reverse position also limits the current so it is not possible to go the same speed in reverse as you can in the forward position. There are three positions on the switch for forward. These are designed to help the operator manage the power use more easily. The first two positions limit current, the first position more that the second. The third position is for maximum power.

Since the car is AC drive, regenerative braking is easy to design into the vehicle. Regenerative braking (regen) puts about 10% of the power back into the batteries and reduces wear on the brakes. Solectria has done this differently than most manufacturers however. They built the regen into the accelerator. The first half of the travel on the accelerator is the variable regenerative control and the second half of the travel of the accelerator is for acceleration. It takes a little time to understand that nothing happens at a stand still until the accelerator is a little more than halfway down. However, once you are up to speed you realize that there is much more control in the accelerator than with a conventional vehicle. While on the open road you can coast by holding the accelerator in the center position. By backing off a little there is a little resistance, which slows you down. Backing off more and you will hear the relay turn on the brake lights since you are braking lightly. The more you back off the more regen is present. It is possible in stop and go driving or in a city with many stop signs to use only the accelerator to control the speed of the car. This is a very convenient, safe and efficient option for this type of driving.

The charger in the Solectria Force is a Brusha charger (made in Norway). It is a unique design to most other charges because it is really two 110vacchargers combined to give 220vac. This allows the owner to charge on either110vac or 220vac using the same charger. The adapter cable supplied by Solectria simple has a NEMA 5-20 plug on one end and a NEMA 6-20 receptacle on the other. The standard Solectria has a NEMA 6-20 inlet under the old gasoline door and they supply you with a 25' cable to connect. Clearly it is much faster to charge using 220vac but there are many times when you are in locations that only have 110vac and it is great to have this option.

Other features include a safety device, which assures the parking break is set when you turn off the ignition. There is a red light and an alarm that sounds if the break is not on hard enough. Since there is no Park position gear pin to lock the car in place this is an important addition.

Solectria recently had to make some changes to their building plan and prices because the Chevy Metro has been discontinued and Solectria can no long get gliders (cars without motors) from General Motors. They now must purchase Metros with motor and then remove the motor and sell it, which is much more costly. So in 1999 the Force list price was $33,000 and it is now$41,000. Also, since this is not their main business they must have deposits from 6 customers to begin a run vehicle. Because of this, I don't expect to see many new customers in California even with the $9,000 incentive.

TH!NK City
By Will Beckett

Years ago I was intrigued by a small two passenger car used as a station car in Berkeley that had a thermal plastic body that looked much like an ice chest one might take camping. This car is fully recyclable since the body can be melted an reused and the steel chassis and aluminum cage are also easily reused. Color is in the plastic so there is no paint. What impressed me most about the car when I first drove it at the Silicon Valley Rally at Stanford in 1997, was how roomy it felt to be in such a small car. The windshield is about twice as far from your face as a standard vehicle and there is a good-sized cargo area behind the front seats. I didn't really like the feel driving the car because, at the time, the ride was hard and there seemed to be a roll feel of a car from the 1950's.

Since this time Ford created a division called TH!NK and purchased the company (Pivco) that manufactured this vehicle. They have now introduced it to this country using Hertz as the agent. There are many station car options allowing the vehicle to be shared by two to three people a day on subscription or you can now rent the car by the day, month or longer. This program is currently using about 450 TH!NK Citys made to European standards with a special permit from the Transportation Safety Department to use them on a three year trial basis in this country. However, TH!NK has plans to manufacture an American version that will be available in 2002 for sale in this country.

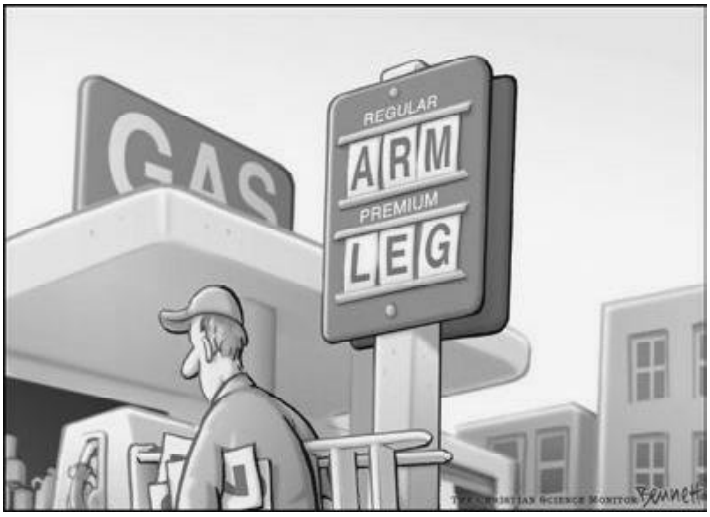
Hertz in Palo Alto, CA has been renting out these vehicles for about two months now and they are very popular. Most have been renting them for a week and then find that they work our so well that they have been extending this to the six-month rental offer which gives a price break over the monthly rate.

The car is two doors and two passengers and all the Pivco components (including the Brusha charger) have been replaced with Ford components. There are many safety features built into the car and to my mind more than are needed. After you turn on the key you must do an extra turn (with the drive control in Park) to activate a system and unlock the drive train locking pin. However, the drive control lever is really very nice. It is a small drum with a flap mounted vertically in the center of the dash below the radio and air controls (they call it a gear selector). It rotates up and down through Park, Reverse, Neutral, and Drive. The acceleration can be quite snappy and handling is much improved over the original Pivco (Lotus suspension). There is a large hatch in back that not only allow easy access to a large cargo area behind the seats but also give amazing visibility for the driver when backing the car.

The top speed is 56 miles an hour and a range of 50 miles, so it is not intended for freeway commuting. However it is a great second car for all the activity that goes on around the home such as shuttling the kids between events and grocery shopping. Also as a station someone else coming in on the train can pick up car that could be driven from to home to the train station, then the car. They then drive it to work where it can be used as a pool car during the day until the worker needs to return to the train station. Then the person coming home on the train can jump in and drive it home where he/she can put it on a charge for the night.

The car is fitted with an Avcon connector to deliver power to the on board charger. It plugs in on the front driver side of the vehicle. It has NiCad (Nickel Cadmium) batteries, which weigh 550 lbs. and hold about 11.5 kWh of energy. The motor is a liquid-cooled 3-phase AC induction motor. Battery voltage is 114vdc, tires at 155/70 R13 at 36 psi. It has front disc and rear drum brakes. It uses a 3kw electric heater but there is no AC.

I have been most impressed with this rental program because it is the very first time that the general public can get in an electric and use it the way they would for their daily activities with no long term commitment. Some people who have just been on the edge of jumping to electric have no hesitation renting one for a week and trying it out. Many of these people have extended the rental to six months. I would recommend this to anyone that has a mild interest in driving electric



by Bob Wing, Copyright 2000

I have missed having an EV. I sold my electric '59 MGA Roadster just over a year ago after daily use for 27 years. In my search for a replacement EV, I found one with a sticker on the windshield that read "Manufacturers Suggested Retail Price $49,105, with no extra charge for electric motor and nickel metal hydride battery pack, $5k Air Quality Management District discount, destination and delivery total $44,810." But then it continued with "incentive discount $30,000, with a total MSRP $14,810." I don't ever expect to see a discount like that again.

Ford no longer sells the Ranger EV but was instead was leasing these Rangers last year for $399/month. On Christmas day I saw on the internet EV discussion list that the Senator Ford Dealership in Sacramento, California, was leasing for 3 years the Ranger EV pickups for $199/month with the NiMH batteries provided free. Two hundred Ranger EVs were available in California but most went to non-profits and government agencies. After these 200 EVs are gone, the lease will be $1300/month. This new price no doubt reflects the added cost the $30,000 NiMH battery pack. There is no remainder value to me after the 3 years but I appreciate that I will have only routine maintenance to do.

My Ranger was delivered to me by flat bed truck on Feb 16 , 2000. My nearest dealer, Hansel Ford in Santa Rosa, has two mechanics trained in EVs, one who will come to the rescue if the electromotive system fails. If the Ranger cannot be repaired on site they will have an EV or gas car for me to use temporarily.

Charging can be a problem for me when I go over the hill to US Hwy. 101, as useful range is about 60 miles, just about the distance of my round trip with no side stops. There are over 250 free public charging stations in Sacramento County, thanks to the Sacramento Municipal Utility District. There are also free charging station to the San Francisco Bay area but mainly on the east side to San Jose and then north to San Francisco.

In Marin and southern Sonoma Counties there are few free public conductive AVCON stations. There is one in Petaluma and another in Novato. Several more are available for the GM EV1, which uses the inductive paddle.

The most helpful charging support would be 2 AVCON's, in addition to the already installed 2 inductive units at the Larkspur Landing Ferry Terminal parking lot for ferries to San Francisco. The charging time is 3-6 hours, depending on the discharge level — but only for inductive now. It is ridiculous that US EV vehicle manufactures cannot get together and have a common plug-in charge system. After all, people have been plugging in conductive cords for 100 years now.

Instead of hard wiring the EV Power Pack AVCON connecting box to the electric breaker panel, I use a stove plug 14-50 and carry the box with me to an RV park, or to EV friends with similar receptacles. I have had as many as 4 EV friends charging their cars at one time at the 240 VAC, 30 A breaker at my house. Ford recommends a 40 A breaker but 15 years ago, when I built my garage, I used underground conduit for a 30 A breaker. The 30 A breaker does not even get warm and I hope this electric supply setup lasts.

The fuel gauge in the EV is about as accurate as one in an ICE car— do not depend on the low end reading. The best idea is to set the trip distance to zero after every charge and avoid driving more that 60 miles. The Ranger EV motor is 67 kW (90 hp), with swing shafts at each end driving the two rear wheels; torque 140 ft/lbs. Use of the heater or air conditioning reduces range up to 15%. There is a radiator in the usual place to cool running temperatures of electrical components and the electric drive motor.

Here are some performance statistics and vehicle specifications from the US Dept. of Energy test of a 1999 Ford Ranger qualifying that this vehicle met all the EV America minimum performance goals:

Acceleration 0-50 mph
At 100% SOC: 10.3 sec
At 50% SOC: 11.2 sec
Max. Power: 84.13 kW
Performance Goal 13.5 sec at %50 SOC
Maximum Speed at 50% SOC at 1/4 mile: 62.1 mph
At 1 mile 74.6 mph Ford has the speed pegged at 75 mph

Constant speed Range @ 45 mph
Range: 115.0 miles
Energy used: 27.81 kWh
Average power: 10.94 kWh
Efficiency: 242 Wh/mile
Specific Energy 57.3 Wh/kg

Constant Speed Range @ 60 mph
Range: 74.2 miles
Energy used: 28.63 kWh
Average Power: 21.52 kW
Efficiency: 362 Wh/mile
Specific Energy: 55.3 Whr/kg

Grade-ability
Maximum Speed @ 3%: 67.4 mph
Maximum Speed @ 6% 58.9 mph
Maximum grade 39.9 %

Charger

AVCON inlet Connector in front near right headlight, input: 187-260 VAC
Max. DC Charge Current: 13.57 A
Maximum AC Charge Current: 24.96 A
Time to recharge: 8 hrs. 13 min
The performance goal was 8 hrs., only test goal where the Ford Ranger failed.
Energy cost with Pacific Gas and Electric Co. at 485 Wh-AC/mile = 6.94 cents/mile
Battery pack located under the body
Panasonic Nickel Metal Hydride, 25 modules weighing 18.54 kg each, 12 V each, total system 300 V, capacity at C/3 rate 95 Ah. Located under the body.

Weights
Curb weight delivered: 4196 lbs.
Distribution F/R: 5l-49%
GVWR: 5350 lbs.
Payload: 1154 lbs.
Performance Goal: 600 lbs.

In the rural area of National and State Parks where we live, it is great to drive to the Pacific Ocean in my new EV to watch the surf in a storm, see the elephant seals on the beach, and watch the whales go by offshore. The hills are now green, dairy cattle are in the fields, moose and deer feeding, lots of different birds, and on occasion I have seen bobcats and mountain lions.

The hills go up to 1000 feet or more so the regen braking is helpful and feeds power back to the batteries and saves brakes. There is no transmission but the selection on the "gear shift lever" provides park, neutral, and drive at freeway speeds plus an economy position to extend range with lower acceleration and provide more regenerative braking for driving under 55 mph.

Ray Roy, Fleet Sales Manager, Sacramento, was very helpful in taking my order and making arrangements for delivery, all entirely by phone. We now again have two EVs in west Marin County — my EV Ranger and Jerry Hudgins GM EV1.

Photo on left of Allen Hopkins with his 2000 Ranger EV, one of four in San Luis Obispo, California. Photo on right of Bob Wing charging up in San Rafael, California.

New Range Availability on My Electric Ford Ranger Pickup.

by Bob Wing, copyright 2001

I have a 3-year lease, $199/month, on my electric 2000 Ford Ranger Pickup. I have been driving it for 14 months now but never have exceeded 56-58 miles per charge. Some Ranger drivers on the Internet EV List have been quoting ranges of 70-85 miles per charge. I wanted the same.

On April 17 I drove my 2000 Ford Ranger pickup to my nearest Ford EV service technician in Santa Rosa, Luke Ammann, Shop Foreman at Hansel Ford, 45 miles north of Inverness where we live. He asked me to come back in four days to see if he could improve the range.

I got a ride back to Santa Rosa with a friend to pick it up in a driving rain storm, — 1 inch of rain that day. I drove the Ranger up Sonoma Mountain Road where Russ Kaufmann (RUSSCO) lives. Russ had built my controller that I used for 11 years and later several chargers in the Fire Chief, my electric '59 MGA Roaster which I had driven for 27 years. I wanted Russ to drive the Ranger up and down his hills as he had not seen it before. Then I left to cross three more ranges of hills and home at 74 miles, a great range improvement. My hill climbing was probably about 2800 feet. The power limit light was on for about the last 7 miles and I barely got up the 200 feet elevation to my driveway and Avcon charger.

Luke had told me he had charged and discharged the pack 3 times in 3 days and went 82, 86 and 92 miles per charge. But that was mainly freeway driving at 55 mph on Hwy 101, with only a few hills and also using most of the power limit in the last 8 miles. The great thing about this range improvement service was that Ford EV paid for it. Others with Ford Ranger leases were getting a longer range on delivery. My lease was from the Senator Ford agency in Sacramento Calif. They did a poor prep job in not providing the maximum range.

Two days later I planned a more water level route around the south side of Tomales Bay and north on California State Hwy 1. It was a blue water day, green hills, lots of wild flowers, little traffic and I returned after about 1800 feet of climbing at 89 miles per charge, this time not using the 8 miles with the power limit light on except for the last mile home. There is always the AAA Tow 6 miles from my house to get me home should I miscalculate

With this increased range I can do more errands and visits as 50 miles is required just to get to Hwy 101 and back from our house. There is one free public Avcon charge station in Petaluma — old Indian name, in Sonoma County — and one at Novato Cosco in Marin County. All the other counties in the SF Bay area have many more Avcon and GM EV1 paddle charge stations. The Avcon charge location most useful would be the Larkspur Ferry Landing, passenger ferry to San Francisco, but only two EV1 charge stations are there. The ferry ride gives one something great to do while waiting for a battery charge and you can get a mixed drink on the ferry in the afternoon.

On May 1 I drove the Ranger to the Sonoma County headquarters in Santa Rosa for the Clean Air Day show. There were 30 AF vehicles at the show - EVs, NG cars, buses and waste truck, city cars and neighborhood vehicles. Ford Th!nk had at least 6 vehicles including the Ford 2000 with Li-Ion batteries.

It was 48 miles each way, an Avcon charger was available at the show site so the Ranger received a 2 1/2 hour charge there. I had an appointment for factory recall item at Hansel Ford, 3 miles south. It turned out there were

2 more recall items since my last visit. First to do, stronger bolts with Locktite added to hold the AC motor/transaxle housing in place. Then a Battery Control Module improvement to extend the range per charge. A replacement oil pump was not in stock yet so another trip to Santa Rosa is required. With another 3-hour charge at Hansel I had full range again so no problem driving home with the A/C on.

News this week was that there would be a new Avcon 50kW charger available in about 3 months to provide a recharge in 15 minutes. I hope that at least one of those will be installed in Marin and Sonoma Counties along Hwy 101.

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bash the mandate. When the first rolling blackouts hit earlier this year, automakers immediately suggested that electric cars would worsen California's power shortage, even though every other analysis shows that the drain on the state's power grid by electric vehicles — usually charged at night, when power demand is lowest — would be insignificant for years to come.

There are billions of reasons why automakers, oil companies, and other industries reliant on the status quo want the state mandate dead. Those reasons are the dollars to be made from a complex worldwide transportation system built around an internal combustion engine fueled by dead dinosaurs. But over the past decade automakers, prodded by ever-tightening government emissions and fuel-economy regulations, have in fact developed cars that are far cleaner than anyone would have thought possible not long ago. Today the performance of the best electric cars is much closer to that of gasoline-powered cars. But gasoline-powered cars are much closer to electric cars in terms of tailpipe pollution.

Already, a 2001 sedan that meets what the state calls LEV, or "low emission vehicle" pollution standards, is 97 percent cleaner than a new car from the early 1970s. On the drawing boards and heading for auto showrooms are cars that meet SULEV — super-ultra-low-emission vehicle — pollution standards. Those will be 99 percent cleaner than a car from the pre-emissions-control '70s, and the manufacturers must certify that they will still meet those pollution limits with 150,000 miles on the odometer. The reality of manufacturing tolerances means that, given regular maintenance, SULEV cars and trucks will stay clean for their entire life spans. "Essentially, we've taken out almost all of the emissions from the tailpipe," says Donn Walker, a regional spokesman for General Motors. "Everyone wants cleaner air; we just disagree on how to go about getting there."

When a CARB board member asked at a hearing in January for a volunteer to stand in a closed garage with a running, brand-new ultra-low-emissions car, one person — an auto company employee — raised his hand. Either this guy had complete faith in new cleaner-burning cars or he was willing to take one in the lungs for his company. He may not be so crazy. Nissan markets a car, the Sentra CA, that runs so cleanly that the company claims it pollutes less during a moderate daily commute than a regular car does parked in a driveway with gasoline evaporating from its fuel system.

Indeed, major advances in the war on air pollution have occurred without the large-scale use of electric cars. "Ten years from now, every new car will be clean, SULEV or better," says Michael Gage, president and chief executive officer of CALSTART, a Pasadena-based research and consulting consortium for clean-air transportation technology. "That answers part of the problem. But it doesn't answer the whole problem."

As in every environmental battle fought in this nation, from water pollution to airborne emissions to chemicals seeping into the soil, the easy steps that provide the biggest gains have already been taken. It's the last yard that generates the most bitter fighting.

In September 1990, after two days of testimony and debate, the California Air Resources Board adopted a clean-cars program that was breathtaking in scope.

The board required that, by 1998, 2 percent of all cars sold in the state emit no pollutants from their tailpipes, and 10 percent meet that standard by 2003. It also ordered cleaner-burning gasoline onto the market within two years and set a timetable for tightening emissions from regular cars. By 2003, cars sold in California would be the cleanest in the world. By the first years of the 21st century, as many as 200,000 electric cars were expected to be whispering along California's streets and freeways.

Although the board didn't specify battery-powered cars, there was no other technology automakers could hope to have in place by 1998. "Fuel cells [a sealed box in which a chemical reaction creates an electric current] were a known technology, but I don't think there was any real sense they would or could be a practical automotive technology in the near term," says Michael Coates, executive editor of Green Car Journal.

In 1990, putting electric cars into consumers' garages hardly seemed impossible. Earlier that year General Motors had unveiled a prototype called the Impact, and by electric-vehicle standards it rocked. It could whip from zero to 60 in under eight seconds, break the 100-mile-an-hour barrier, and travel 120 miles before needing a recharge. GM Chairman Roger Smith anticipated cranking electric cars off a production line by 1995. His engineers were stoked by what they had wrought. John Zwerner, executive director of GM's advanced engineering staff, said the Impact "absolutely shattered" the perception of electric cars as plodding golf carts.

But EVs had problems that would prove increasingly vexing. The Impact's expensive battery pack wouldn't last more than 25,000 miles, and it cost $1,500 to replace. If battery life could be extended, if gas prices continued to rise, and if there were a market for 100,000 or more EVs each year, GM officials figured they could make money on them. But even then they were skeptical — they'd been down this road before. In the wake of the gas crisis of the early '70s, GM had rushed out the experimental Electrovette, a battery-powered Chevette. But when gas prices dropped, so did virtually all interest in developing the unpleasant little compact.

So before plunging into the unknown in the early '90s, Detroit took a hard look around. The nation was in recession, and California was suffering more than most other states. Billions in research and development would be needed to produce cheaper, longer-lasting batteries that could handle a commute from, say, San Jose to San Francisco. And there was no guarantee of success. It was the wrong time, auto execs concluded, to dump a pile of money into electric cars.

And it was the right time to go on the offensive against "anti-business" regulations, especially in California, where no one wanted to be the bureaucrat who shut down factories and cost people their jobs.

By 1992, industry groups were filing objections to California's clean-air plan with federal Environmental Protection Agency officials, delaying what was usually a rubber-stamp approval from Washington. In October 1993, when board members of the American Automobile Manufacturers Asso-

ciation met in Detroit, the main agenda item was creating a common, industry-wide strategy to crush California's zero-emissions mandate.

Ford had forged ahead on its own. In September 1993, Ford Vice Chairman Alan Gilmour met with Gov. Pete Wilson and told him that no matter how much money Ford pumped into developing an electric vehicle, it had little chance of meeting the mandate.

The smackdown was on — and on a number of fronts. GM had already announced it was dropping its ambitious plans for EV production and was switching to a "pilot" program of just 50 Impacts nationwide. Automakers offered to build clean-burning regular cars sooner than the EPA required, and announced a plan to build an 80-mile-per-gallon car within a decade. Such pronouncements were viewed within the environmental community as designed to undercut the zero-emissions program. Ford unveiled an electric-powered van, then said a three-year lease would cost an eye-popping $100,000. Then a Ford prototype caught fire and burned to the ground.

A month after the Detroit meeting, CARB Chairwoman Jananne Sharpless handed her resignation to Wilson. Sharpless was a fierce supporter of the zero-emissions rule, and even though environmentalists weren't always happy with her policies, they saw doom in her departure. She'd also managed to piss off the trucking industry over new regulations for diesel fuel, and Wilson had formed a secret task force to analyze the CARB board's performance under her direction. CALSTART's Gage was one of the environmentalists who saw her exit as a blow to the zero-emissions mandate.

"There is no direct evidence, but I was certainly one of those who believed that the industry had helped force her out," Gage says.

Sharpless' departure was the turning point in the political battle over zero-emissions cars. From then on, it was painfully clear to environmentalists that no matter what the state air board decided, there was always a higher authority to appeal to — one that was more sensitive to political pressure. And pressure there was. Ford lobbyist Steve Blankenship bluntly announced that his employer's plan was to "ask that this rule be set aside." The phrase "astroturf lobbying" was coined to describe the faux "grassroots" groups that popped up to oppose the mandate. One was called Californians Against Hidden Taxes, but it was funded by the oil industry.

Firefighters were baited with incentives from the auto industry to show up at CARB hearings and complain that trying to extinguish a burning EV or fuel-cell car would be dangerous. The heavyweight L.A. lobbying firm Cerrell Associates Inc., hired by Detroit to drive a stake through the mandate's heart, estimated that automakers poured $500,000 into the fight in the first half of 1995 — the year in which anyone planning to build a 1998-model car would have to retool their assembly lines.

Cerrell may have underestimated the torrent of lobbying cash. A study by the California Public Interest Research Group said that between 1991 and 1995, oil and auto companies spent $29 million on lobbying in

California. That figure included nearly $4 million in contributions to legislative candidates statewide, and nearly a cool million to Wilson. It may sound like a lot, but compared to the cost of building electric cars, it was nothing. And there was a higher principle at stake, says Allen J. Scott, director of the UCLA Center for Globalization and Policy Research, and an expert on the EV industry at the time. "What [automakers] were scared of was losing control of the agenda," he says. "They were particularly concerned about Southern California not only using electric cars, but manufacturing them. The arrogance of GM, in particular, has been remarkable."

It was not the first time big automakers, with the assistance of the oil industry, decided to reshape the transportation landscape to their liking.

Between 1936 and 1950, National City Lines, a holding company controlled by GM, Firestone, and Standard Oil of California, bought out more than 100 electric trolley systems in 45 cities, including L.A., New York, Philadelphia, St. Louis, Salt Lake City, and Tulsa. The popular public transit networks were dismantled and GM buses took their places. In 1949, the National City partners were convicted in federal court in Chicago of criminal conspiracy. The penalty? A $5,000 fine.

Nearly half a century later, the automakers and oil refiners staged another stunning coup, this time at CARB. In March 1996, the state agency repealed much of the zero-emissions mandate, including the 1998 deadline for getting the first EVs on the road.

CARB caved in partly because of its own fears — specifically, that hideously expensive battery-powered cars with little range would stack up on dealer lots. Such an outcome would have done little toward regulators' goals of cleaning the air and advancing clean-transportation technology. Yes, the agency could have fined automakers $5,000 per gas-powered vehicle sold, or taken them to court. But fines don't do much to clean the air — or convince drivers to buy EVs they don't want. Instead of imposing firm goals, CARB allowed the automakers to secretly set their own quotas for producing emissions-free cars. The agency refused to publicly disclose how many vehicles the manufacturers would produce, or to penalize them for missing those goals — whatever they might be.

Environmentalists dismissed the agreements as not worth the paper they were written on. CARB board member Ron Roberts accused the automakers of waging a campaign to smear the electric car and complained that even board members wouldn't be told how many zero-emissions cars Detroit actually agreed to build. "We were being told that the agreements were just a floor, a minimum of what the auto manufacturers were going to do," recalls Tim Carmichael, executive director of the Santa Monica-based Coalition for Clean Air. "And we told CARB that the industry would only do what they were forced to do, and it turns out they didn't even do that. There was a lot of outrage. We knew what was going to happen."

Carmichael and other pessimists turned out to be right. Honda pulled the plug on its EV program after meeting the "goal" it had secretly negotiated with the board — a measly 300 cars. Others didn't even bother to meet their pathetically modest goals. "[The secret agreements] did not work," admits Mike Kinny, CARB's executive officer. "We do not have cars being offered in the market. [The manufacturers] did not comply."

Facing an expensive, fruitless court battle to enforce the secret pacts, CARB essentially gave up on them. But the industry has not reduced its pressure to gut the zero-emissions rule. In the last quarter of 2000, GM alone spent nearly $175,000 on lobbying against the mandate.

Stomp on the accelerator of Lisa Rosen's little EV1 and the front tires squawk, protesting the sudden overwhelming power.

Electric motors produce a lot of torque, particularly from a standing start. And the speed continues to grow, and quickly. When it was introduced, the EV1 was quicker from zero to 60 than some Acura models. With the most sophisticated batteries, it will run 150 miles on a charge. For all practical purposes, Rosen leaves the house every day with all the fuel she needs. Even with multiple EVs charging at her house, her electricity bill never exceeds $70 a month — and the recently installed solar charging panels atop her home will slash that bill even further. A quick-charger that can be carried with the car will bring the vehicle from 15 percent to 80 percent charged in two hours — and even more rapid chargers are in development.

EVs are inherently simpler to build and smoother-running than traditional cars, and General Motors engineers created a truly amazing vehicle in the EV1. Its shape is slick, its fiberglass body is light, and its tires offer minimal rolling resistance. It's probably safe to say that if GM could have produced this kind of vehicle in the early '90s at reasonable cost, electric cars would not be such a novelty today.

But there was another development in those years that, in hindsight, may have signaled the beginning of the end for electric cars.

In 1992, Honda announced that it would be able to meet tighter 1994 pollution standards a year early with its Civic VX Hatchback. A bigger catalytic converter, a better oxygen sensor, improved fuel injectors, and — shazam! — the dirty old internal combustion engine was cleaning up its act faster than expected. Automakers knew they had to offer a clean-air alternative if they were ever going to kill off the zero-emissions rule. Why not find an alternative more to their corporate liking? They applied cattle prods to their engineers and made them produce cleaner-running cars than were thought possible.

By August 1995, Honda had certified several Civics as low-emission vehicles, and by November 1999, CARB had approved models by Honda and Nissan as SULEVs — super-ultra-low-emission vehicles. With a sealed fuel system that allows no gasoline to evaporate and a guarantee that the pollution-control systems will work for 150,000 miles, Nissan's is so clean that state regulators agreed to give the automaker partial credit toward its zero-emissions goal.

Nissan says its SULEV might fail to meet pollution standards at 150,000 miles if the owner forgets to change the oil on a regular basis. The incremental extra wear in the cylinders could allow a baby's breath of oil from the crankcase into the combustion

chambers, introducing new and additional pollutants into the exhaust stream. Engineers charged with further cleansing the internal combustion engine certainly are working in the realm of diminishing returns. But what they have wrought is dramatic. By the state's own admission, SULEVs are eight times cleaner than the ultra-low-emissions vehicles available on dealers' lots today — and more than 99 percent cleaner than pre-1990 cars.

Faced with numbers like that, state air-quality officials felt in January that it was reasonable to give the automakers that built SULEVs partial credit toward meeting their zero-emissions goals. Technically, 10 percent of all cars in the 2003 model year still have to be zero-emissions vehicles — but you can build other types of clean-air vehicles and get credit for up to 8 percent of that goal.

Automakers don't have nearly the problems — technical or philosophical — building them that they have with electric cars. Detroit's representatives bitched and whined relentlessly to CARB about being required to make up to 15,450 zero-emissions cars by 2003. But the automakers didn't blink at building roughly 100,000 ULEVs or SULEVs by that year — and more than 400,000 by 2006.

"My heart wished very much to be as close to the original mandate as possible," says CARB Chairman Alan Lloyd. "But that was too optimistic. We needed to continue the pressure, but we have to recognize some of the limitations the manufacturers are up against."

And truth be told, the Holy Grail of electric cars — batteries giving them the range and flexibility of gas-burning cars at an affordable price — remains elusive, although tremendous strides have been made. But whether automakers put enough money and effort into the research is a matter of sharp debate among those on the cutting edge of clean-air transportation.

"I believe there was a good-faith effort. Whether it was as much as could have or should have been done, that's the issue," says Coates of Green Car Journal. "Part of it is a technology issue, but a big part is the cost issue; the expectation was that costs for advanced batteries would drop, like computers did, but that did not happen." Lloyd echoed those sentiments. "What we ran into are some fundamental cost issues which are proving more intractable than we thought," he says.

Not everyone agrees. Stan Ovshinski, president of Energy Conversion Devices in Troy, Mich., lives for technological breakthroughs. The man virtually created solar-energy cells, holds 250 U.S. patents, was named a "Hero for the Planet" by Time magazine in 1999, and is probably smarter than any 10 people you know combined.

"The people who are saying that battery technology isn't ready are absolutely wrong," he says. "It's part of the party line. It's self-perpetuating. It's very sad. You tell a lie big enough and long enough and people start to believe it. The fact of the matter is volume. That's the only reason batteries are the cost they are."

With the advances in pollution controls for gas-fueled vehicles, the question isn't really whether the mighty car industry, with its massive financial and technological resources, can actually put an electric car on the market. It's whether it's really necessary. GM's Walker cheerfully concedes that the EV1 is one badass little car. And if the market volume was there, he says, the price would drop well below the $100,000 GM figures the car costs to produce.

But even CARB acknowledges that in the best-case scenario, a battery-powered car will cost at least $20,000 more than a comparable gasoline-powered vehicle. And there are hidden costs. For example, how much would a dealership have to invest in equipment to service an EV?

Vehicle emissions make up nearly three-quarters of the smog-forming pollutants in L.A.'s skies, and there is little argument that slashing tailpipe emissions will be necessary to meet federal air-quality standards. The question is how to slash them.

According to CARB's calculations, putting hundreds of thousands of ULEVs and SULEVs on the road — something the automakers are willing to do to meet the revised zero-emissions mandate — will cut pollution about as much as putting a far smaller number of pure zero-emissions vehicles on the roads. And requiring SULEVs to stay that way for 150,000 miles means more of them will work their way into the hands of poor people, eliminating the older, barely running cars that belch the most air pollutants per mile.

"It's not that we can't [build electric cars]," Walker says. "It's that we don't think it's the right thing to do. In financial terms, it's insane."

The scene might not have been insane, but it was completely surreal.

The inspector wandered through the home of Lisa Rosen and Doug Korthof, checking to make sure the new arrival would have a good environment to live in. The couple had already passed the initial screening. They were a two-car family, they were both over 25, they had a house with an enclosed garage and good wiring, their income was adequate. All they had to do was pass the house inspection, sign the lease papers and Honda would hand them a bouncing baby EV Plus, the company's latest foray into the electric-car market.

"I swear, it was more like an adoption than buying a car," Rosen recalls.

From the beginning of the zero-emissions-vehicle mandate, Detroit and Japan have repeated, mantralike, their contention that people would not buy underpowered, limited-range, expensive electric cars. But their marketing and development strategies have left critics convinced that they never gave the market a chance.

Even today, trying to buy or lease an electric car is amazingly difficult. For example, Ford's EV Ranger, a battery-powered light truck, is technically on the market in California. But only 148 of them are available nationwide.

"I have had salesmen tell me, "You don't want that,'" Korthof says, relating his experiences in trying to pry an EV out of a dealer showroom. "I have pulled out my check-

book in dealerships, pointed to the car and said, "Give it to me, let's do the deal,' and they'll say, "No, you've got to talk to a specialist.'"

Walker of General Motors responds that automakers must explain to potential buyers what an EV can and cannot do, and many people who initially express interest turn away after learning the details. And there are a lot of very rational business reasons for dealers to want to stick with the products that makes them money: regular cars and trucks.

At least GM made a real stab at building an electric car from the ground up. Other manufacturers simply converted regular cars, trucks, and vans to electric power, and those always will be engineering compromises.

Chrysler simply didn't bother to put much money into developing an electric car, eventually coming up with a van so crappy that many in the environmental community thought it was intentionally designed to prove that EVs weren't ready for production yet.

In 1999, Honda announced that it was halting production of its EV Plus. At about the same time, Southern California Edison announced that it was shutting down a subsidiary that was planting charging stations around the Southwest. CARB officials doubt that any private motorist ever actually bought or leased the Chrysler van. Automakers say their experiences proved that no one wants an electric car.

But entrepreneur Mike Corbin, of Hollister, built a nifty little one-seat electric car, put it on the market, and got so many orders that he's moving into a bigger factory this year. Corbin, who made a fortune selling comfortable motorcycle seats, asked himself a question back in the early 1990s: If most people commute alone, why not build a car for one person? He sank $5 million of his own money into the answer and came up with the Sparrow.

Since he introduced it in 1999, Corbin has sold more than 200 Sparrows, and he has a waiting list of about 1,000 customers. The Sparrow is freeway-legal, insurable, and licensable in all 50 states. It's legal for carpool lanes, and the latest models are fully chargeable within 20 minutes from any regular 110-volt outlet, company officials claim. "Everybody laughed at this, but Mike is a visionary," says Ron Huch, president of Corbin Motors. "It's something that the car guys aren't willing to do. They think in terms of 100,000 units, and they are absolutely committed to full-size cars. To date, we've invested only $15 million — Detroit couldn't get a committee together for that."

To CALSTART's Gage, the market hasn't been adequately tested. "Has there been a good-faith effort to meet the demand? No. To the best of my knowledge, there has been a waiting list for every electric vehicle made," he says. "But there's no question that the automakers have lost money on every one they've made."

With newer battery technology, electric vehicles are making some inroads in places they were expected to be years ago. The U.S. Postal Service has taken delivery of Ford's battery-powered postal van. And high-tech batteries, combined with software advances, have revolutionized the potential for hybrid cars like the Toyota Prius and the Honda Insight, though some would argue they aren't quite ready for the market.

Car and Driver magazine tested the Prius, got scarcely more than 35 miles a gallon — admittedly in cold weather, which cuts the car's fuel efficiency — and called it "perhaps the first car that runs on guilt."

But even SULEVs won't meet the no-tailpipe-emissions requirement for 2003, and the marketing battle for pure EVs is expected to heat up again — that is, if the mandate isn't further eroded by automaker and oil-industry political and legal maneuvering. General Motors has filed suit to overturn the mandate, saying it illegally ignores cheaper and more effective ways to clean the air. And Assemblyman Marco Firebaugh (D-L.A.), has introduced legislation to block CARB from imposing penalties on car manufacturers for violating the zero-emissions mandate.

If the mandate survives, don't expect to see fleets of the zippy EV1s hitting the streets. What both Ford and GM are talking about offering are "city cars" -- electric-powered cars that aren't fast enough to travel on the freeway safely. The city cars are supposed to be capable of surface-street travel, but GM's Walker isn't optimistic about putting these smaller, slower vehicles on the real-world roads of hulking SUVs.

"They're unsafe, too small, but they're the only way to meet the mandate without being taken to the cleaners," he says. "People love the EV1, but who wouldn't love a $100,000 car that they're getting for a fraction of that?" Simply put, the existing oil-dependent auto industry isn't going to change its outlook without the carrot of profits dangling in front of it. "The internal combustion engine is here to stay. It's what customers want," Walker says.

Gage of CALSTART has been peering into the crystal ball of clean-transportation technology longer than most. "What will have to happen is what is known as disruptive technology — a breakthrough that makes the existing technology obsolete," he says. "It could be out there, but right now there's just no market for it. The difficulty is finding a group without the investment in the status quo [but] with the financial wherewithal."

Carmichael of the Coalition for Clean Air says the need for zero-emissions cars remains critical, because no matter how clean internal combustion engines get, they will still pollute to some extent. "This never was just about getting big air-pollution gains in 2003," he says. "It is about creating a new system of transportation for the long term, a clean system. And waiting for the automakers to create it on their own is, in my opinion, the least likely scenario. There will have to be the technological breakthrough, the regulators will have to find religion, or there has to be a groundswell from the public. And we see sparks of that — every time the automakers talk about how inadequate electric cars are, the owners talk about how much, in truth, they love them." Detroit automakers have spent millions attempting to unplug California's effort to put electric cars on the road. And so far, Detroit's succeeding.

Alternative Fuel Bill backed in the Senate

Lawmakers say there may be an alternative to high prices at the gas pump - alternative fuels.

Sen. Jay Rockefeller, D-W.Va., joined other senators to introduce legislation to encourage motorists, truckers and retailers to invest in cleaner automobile technologies, including some potentially based on coal.

And as gas prices again begin to rise, signaling another long summer at the pump, the lawmakers are hoping drivers might take advantage of tax credits between $1,000 and $4,000 for cars, sport utility vehicles and light trucks and as much as $40,000 for tractor-trailer trucks using alternative automobile technologies.

Parts of the bill, known as the Clean, Efficient Automobiles Resulting from Advanced Car Technologies, also are geared toward retailers, giving filling stations a 50-cent credit for every gas-equivalent gallon of alternative fuel they sell. Current tax deductions and credits also would be expanded to cover the installation of alternative fuel stations.

"When you deal with alternative fuels, you have to have a willing buyer and a willing seller," he said. "In the classic case, what would happen is those who buy alternative fuel cars would have no place to buy fuel. Or stations would invest in alternative fuels, and no one would come to the pumps."

The current legislation also has the backing of several major automakers, including Ford, Toyota and Honda, and a number of environmental groups.

While alternative fuel cars do cost more - a Ford hybrid electric vehicle expected to go on the market in 2003 would add about $3,000 to the current vehicle price, alternative fuel prices often are lower. The bill aims to get drivers behind the wheel of alternative fuel vehicles in the first place. Currently, two alternative fuel vehicles are sold in the United States, Honda's Insight and Toyota's Prius.

Alternative fuels covered by the legislation include natural gas, ethanol, methanol, hydrogen for fuel cells, biodiesel and bioethanol, coal bed methane and gasified coal. The legislation could cost between $8 billion and $10 billion over 10 years.

04/25/2001 Charleston Gazette

GM takes California to court

It's no surprise that trying to clean the air by getting people to drive electric cars is a California idea: It's the perfect melding of the Golden State's historic smog problems with its taste for utopian technological innovation. Yet the battery-powered electric vehicle may be a technological and commercial dead end, even as it remains central to the California air— quality program now being emulated by New York, Vermont, Massachusetts, and Maine. No wonder, then, that the biggest car maker, General Motors, and several of its dealers are suing for regulatory relief in state Superior Court in Contra Costa County.

In the late 1980s, utilities and environmentalists pushed for laws forcing the introduction of zero-emission vehicles to California's car lots. In 1990, the Califor-

nia Air Resources Board, which has broad powers to regulate emissions throughout the state, decreed that carmakers would have to put a percentage of ZEVs in their showrooms for sale. The mandate was to be phased in through 2003, when 10 percent of all new cars offered for sale were to be electric. CARE relaxed that number several times, most recently in 1996 to 2 percent.

The board wanted to allow extra time for "a market-based introduction of ZEVs... and to promote advances in electric-vehicle battery technology." Originally, the mandate would have translated into some 170,000 ZEVs, but the figure was subsequently slashed to 22,000.

By 2001, however, only 2,200 battery cars were humming along California's freeways. Why? The major reason is that meaningful "advances in electric-vehicle battery" capacity just haven't materialized in a way that would make ZEVs economical to end users, even with massive subsidies and tax breaks offered along the way. There are some high-tech batteries that can take a small electric car more than 100 miles between charges. But they cost about $250,000 each, so the basic production-line ZEV-typified by General Motors' sleek two-seater EV-1 -relies instead on a Lead-acid cell battery that gets about 75 miles to the average charge and adds 60 percent to the cost and weight of the car. (The worn-out batteries are also difficult to dispose of.)

Manufacturers contend that the average customer visiting a Saturn dealer (the EV-1's licensed vendor) would be more attracted to a $19,000 4-door Saturn sedan than a 2-seater EV-1 with an ostensible price tag of $35,000 (which could, in fact, only be leased at $499 a month). Given the higher price and relatively shoddy mileage, demand for battery-powered ZEVs has not developed-despite a passed of tax incentives. Discouraged by stack sales, companies cut ZEV production Last year, with GM-to all appearances-getting out of the electric car business altogether.

The ZEV Lobby, a major presence at CARB meetings, is accusing automakers not of market failure, but of treachery. CARE director Alan Lloyd idealizes the battery-powered car, with its complete lack of tailpipe emissions, as "the gold standard" of air quality, forgetting, perhaps, that this metallic basis for money has been discarded by the world.

While the battery-powered ZEV may be dead, other alternatives are very much alive. CARB's own technical staff recently observed that, while unable to improve the storage battery, science was making much progress in other clean-air technologies. "Hybrid vehicles," which deftly combine electric motors with small, clean gas engines, were emerging, and even some gasoline vehicles were approaching the zero-emission standard due to computer-enhanced emission control. It is also assumed, both by the board and many manufacturers, that hydrogen fuel-cell cars-another zero-emission technology-will be available by 2003.

Last year, the staff asked the board to cut the already abated 2003 mandate for 22,000 ZEVs back to something the market might actually accommodate-around 2,000 more vehicles than are currently on the road. This would favor gas-electric alternatives like the Toyota Prius and the Honda Insight, which are selling well even though they cost about 10 percent more than a comparable gas-burner. The technical staff appears to have assumed that selling hundreds of thousands of hybrid and other very-low emission cars (hybrids are 98 percent clean, not far off the ZEVs' 100 percent) would have a greater net effect on statewide air pollution than putting 20,000 ZEVs on California auto lots.

The auto industry insisted that CARE drop the 2003 ZEV requirement completely, and a battle royal ensued. The result: The board now says between 4,600 and 15,000 ZEVs must be on car Lots by 2003, at a build cost to car makers of up to half a billion dollars. Ford, the only current ZEV maker, eagerly accepted, and other manufacturers tagged along.

But GM sued, contending that building ZEVs was 150 times costlier than alternative clean-air measures such as elimination of diesel pollution and encouragement of hybrid vehicles. CARB's Lloyd clucked, "GM has decided to place its future in the hands of its Lawyers, rather than its engineers."
2001/07/12 Weekly.

TECH TALK

by Lee Hart

Topic: Battery maintenance and determining cost-per-mile.

Roger Stockton wrote:
When a user achieved performance approaching that claimed by the manufacturer, it makes more sense [to me] that this be taken as evidence that the batteries are *capable* of delivering the rated performance when treated well.

It also makes sense [to me] that how this user treated their batteries be carefully noted as an example of at least one way to avoid murdering this particular type/model of battery.

TechMan's response:
Good points. There are lots of variables; some that you can control, and some you can't.

When manufacturers tests batteries, they use an industry standard test method. For example, the BCI test method discharges a 12v battery with a 25 amp load to 80% DOD, recharges, and repeats until the battery delivers less than 80% of its original capacity. If the manufacturer knows such a test will produce unfavorable results, the battery is also tested some other non-standard way to produce better numbers for marketing. Thus the 50% DOD test for Optimas.

In the lab, everything is controlled; time, temperature, current, etc. They finish the test as quickly as possible so calendar age doesn't affect the results. The data for any weak batteries are ignored (they aren't "typical"). More unscrupulous vendors deliberately hand-pick the test samples to insure better results. Thus, battery manufacturer's test results are about as optimistic as you're going to get.

The main hope for improving life over manufacturer's tests is by smarter charging. Battery manufacturers use very conservative charging algorithms, in part because that is what is specified for BCI tests, but also because they only want to make sure the battery lives out its warranty. Undercharging kills batteries quickly; overcharging de-

grades them over time, so they err on the side of overcharging.

In the real world, we have poor control over the discharge current, depth of discharge, temperature, etc. Thus the results are always worse than lab tests. The REAL question is, "How much worse?"

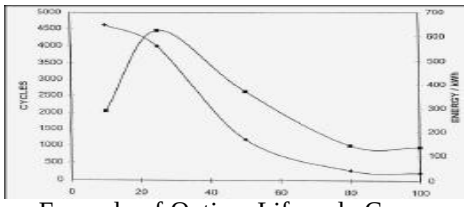
Careless users, uncontrolled chargers, excessive DOD, excessive currents, and poor EV instrumentation that gives the driver no idea what is happening all lead to battricide. The batteries die from abuse long before their laboratory cycle life.

For maximum EV battery life, here's what needs to be done (and isn't in most EVs):

❖ very well controlled charging, that compensates for battery temperature and battery life, and only equalizes as necessary.
❖ some form of battery balancing, to keep them all at the same state of charge.
❖ instrumentation that a) indicates what is going on, b) warns you of problems, and c) shuts down the system if things get too far out.
❖ batteries in insulated boxes, with a means to prevent excessively high or low temperatures.
❖ for flooded batteries, some means to insure proper maintenance (watering, cleaning, checking terminals, etc.).

Even if all these things are fixed, there are uncontrollable variables that will always shorten real-world life compared to lab tests. Temperature, age, and manufacturing differences between batteries are uncontrolled. Discharge currents are dictated by traffic conditions. You might try to consistently limit depth of discharge, but occasionally miscalculate, and have to run them down excessively to get it to a charging outlet.

In my case, I murdered my first few sets of batteries from the usual causes; poor chargers, excessive discharge currents, excessive depth of discharge, etc. As I learned, life improved. The last set of Sam's Club 6v golf cart batteries lasted me 6 years in my ComutaVan. However, I had an excellent Lester dv/dt charger (turned down to prevent overcharging), Cruising Equipment AmpHour meter, kept the car in a heated garage, and the batteries were in insulated boxes. I used it for daily commuting to work, 5 miles each way, at speeds under 40 mph so battery current rarely exceeded 250 amps. Depth of discharge was rarely more than 50%. Even so, I had one battery failure around 3 years (replaced), and capacity was down to about 50% at the end. Total mileage was 12,900 and I paid $500 for the 13 batteries, which is 3.88 cents per mile.



Example of Optima Lifecycle Curve

Because of my short trips, an ICE might get 20 mpg in this service (at best). At $1.25/gallon, it would have cost 6.25 cents per mile for gasoline.

Tech Talk is compiled from various topics and questions fielded by Lee Hart which are sent in through the EV Discussion List. This will be featured as an on-going column in CE

EV Wildlife

by Mitchell Oates

Yep, that was me. The cat's name is Ralph, and thankfully he abandoned ship when I turned on the cooling pump and muffin fans for the liquid cooling setup on my controller. I knew of the feline's fondness for vehicles, and took pains when redoing the truck to ensure that he wouldn't inadvertently check the pack's state of charge when performing his duties as vehicle inspector. There is something to be said for not having an ENTIRELY silent EV.

Now, old Ralph contents himself with sitting on the black tonneau bed cover over that nice large bank of 24 warm batteries, and has learned that when I disconnect the charger cable it's time to find another perch. The only time I've taken issue with this behavior is one night when he decided it was too much trouble to climb down and find a clump of bushes to serve as a restroom, and, well....., I'll leave that one to your imagination.

We also have another cat, a black and white bob-tailed Manx named Bomber (named for the noxious gaseous aftereffects of whatever he eats) that has appointed himself vehicle maintenance supervisor. Whenever I go out to plug it in at night after returning from work, or unplugging it and refilling the A/C ice chest in the afternoon before leaving for work, he is constantly at my heels to ensure that all work is performed to specification. When plugging in the power cord to the charger in the bed, he hops up into the bed and checks out everything there, then hops out and tries to crawl up my leg as if to get my attention and say "OK boss, turn on the juice". When I open the driver's door and sit down for a few minutes to check the e-meter and see that everything is working properly, he hops up into the cab. Then he checks out everything inside, then comes over and sits down on my lap with a loud purr, saying "Everything's fine here, let's call it a night". When I'm done and get out, ready to close the door, I don't have to say a word, he hops down and saunters off into the night, having once again fulfilled his duties.

I swear, one of these nights I fully expect to get woken up by this cat clawing at the window, meowing and raising all manner of hell, telling me to get my lazy butt out of bed because the charger shut off for some reason and I need to go reset it. At least none of these cats are telling me how to drive (not yet, anyway).

I'm also the one that came across the black panther by the side of the road one night coming home from work. As a follow up, there were two or three other reports over the next couple of weeks of other people sighting this beast in the area. Additionally, I found out a month later than another gentleman that also works at Freightliner had spotted the beast on the same night on the same stretch of road that I did, but didn't tell anyone at first figuring they would doubt his sanity or what he actually had in his coffee mug.

CONVERSION WORKSHOP, STEP 5
CLEAN UP, MOTORS, AND ADAPTORS

By Michael P. Brown, copywrite 2001

Now that we have the engine and transmission removed, we have some clean up to do. If you had a running donor car or truck, and had the engine compartment steamcleaned on the way back from weighing the vehicle, there should only be a small amount of cleaning left to do. A few rags and some solvent or cleaner/degreaser should get the places that got missed by the steamer because there was an engine in the way.

If your donor's engine was dead and you are left with a dirty engine compartment once the engine is removed, clean up gets a little harder. The easiest way to get the cleaning done is to find a mobile steamcleaning or pressure washing service, and have them come to you.

If this service is not available in your area, you might be able to rent a pressure washer and do the cleaning yourself. Presoaking the area to be cleaned with spray degreaser makes the pressure washing more effective. If all else fails the solvent or degreaser spray, rags and elbow grease combination works well.

While you are cleaning the engine compartment, don't forget to clean the transmission as well. Pay special attention to the inside of the bellhousing where the clutch lives. This area always has some clutch dust in it, and if the engine's flywheel seal was leaking there will be oil there, too. If there is oil in the bellhousing but the flywheel seal wasn't leaking, check the transmission's mainshaft/input shaft seal to see if it is leaking, and replace it if necessary.

You should keep some solvent, a pan, a brush, and rags handy to clean small parts on an as needed basis. The reason for all this cleaning is to provide a clean setting for your new electric drive. It will also make all the hours you are spending in that engine compartment fitting that drive much more pleasant.

Now that all the cleaning is done, it is time to start installing the new electric drive. Before we get into the actual installation process any further, we should take a moment and look at what it is we are installing.

The mechanical parts of an electric drive are the electric motor, the motor-to-transmission adaptor, and the transmission. In the previous articles of this series, we established the manual shift transmission, including the clutch, as the transmission of choice, so we are only concerned with its relationship to the other parts in this article. That leaves with only the motor and adaptor to discuss.

Motors

Selecting the motor for your conversion is one of the most important decisions you have to make, so let's see what's out there.

Any discussion of motors for electric cars must start with some history. In the beginning of the electric car conversion movement, the motor of choice was the aircraft generator used as a motor. As long as battery pack voltages were low, control systems simple, and range expectations were modest, they were a usable place to start.

However, when the demands for higher speeds and longer range brought higher voltage battery packs and solid state chopper controllers, their reliability and usefulness suffered.

The use of aircraft generators in EVs got a lot of cars on the road, and gave us the starting place for growing the conversion movement and the EAA. The preceding statement defines the place of the aircraft generator in a modern EV conversion: part of the history that led up to it. Unless you are purposely building a historical replica of an early seventy conversion EV, don't use an aircraft generator to power your EV.

The evolution of EV motors continued through the late seventies and early eighties with different technical configurations (shunt vs. series vs. compound), and different manufacturers (Baldor vs. GE vs. Prestolite vs. China motor).

In the end, when issues of performance, reliability, and availability were considered, the GE 5BT and Prestolite MTC 4001 series wound motors were the motors of choice for that time. The only problem with these motors was that affordable pricing was tied to large quantity (100 piece) orders. However, after the failure of a couple of early batch conversion companies, a supply of these motors appeared with affordable prices for individual motors.

The real breakthrough in EV motors came in the fall of 1990 when Advanced DC Motors appeared on the scene. This new company, founded by a group of former Prestolite employees, brought out seven and nine-inch diameter series wound motors to replace the Prestolite and GE motors. Then, after some time in the EV marketplace, an eight-inch diameter motor was developed to fill the gap they saw in their line.

These motors were designed and built to be on-road electric vehicle motors, with proper mounting holes on each end, great power and good reliability. Best of all, the company set up a distributor network and pricing structure that made their motors affordable and widely available.

A recent arrival on the EV motor scene is the massive eleven-inch Kostov motor. Although the Advanced DC motors still dominate the street conversion market, the Kostov's high torque output and ruggedness have made it a favorite of both the large vehicle converters and the drag racers.

What does this entire information mean to a person that is just starting to think about doing a conversion, or is already doing one now? It means that you have available more choices in the size and performance of motors at affordable prices then at any time in

the history of the conversion EV movement. If the motor is correctly sized to the vehicle it is being installed in, and is used intelligently, it will give you many miles of trouble-free service.

Adaptors

The adaptor is the part that links the old with the new in a conversion EV. The skill and accuracy with which it is made has a direct effect on the performance and reliability of the EV conversion. Such an important component deserves some discussion about the function, design, and fabrication of its parts.

The modern adaptor is made up of three major parts, the profile plate, the hub, and the motor ring. Each part has a specific job to do.

The profile plate is a thin aluminum plate whose outside edge matches the outline of the transmission bellhousing as much as necessary and provides the holes that match the mounting holes in the transmission. More important than that is its main job, to accurately locate the motor so that the motor shaft is in perfect alignment with the transmission mainshaft.

In the mating surface of the transmission bellhousing (the surface that rests against the rear of the engine block), there are two holes that are larger than the rest of the mounting holes. These holes match two similar holes in the engine block. Inserted in these holes are two hollow tube sleeves called "locating dowels".

These dowels accurately lock the transmission to the engine with the centerlines of transmission mainshaft and engine crankshaft in perfect alignment. This is important because a few thousandths mis-alignment between the two shafts will cause early failure of the transmission mainshaft bearings and the crankshaft pilot bearing, as well as difficult clutch operation.

The location of the mainshaft centerline and the dowel holes is duplicated on the profile plate by accurate measurement and machine work. From the point on the profile plate representing the mainshaft centerline, the concentric circles for the hub cutout hole and the motor ring locating recess are measured and cut.

Another important dimension in adaptor design is the "magic distance". This is the distance between the furthest back flat surface of the flywheel and the mating surface of the engine block. (The measurement was discussed in the last article about disassembly.) Duplication of this distance in the design of the adaptor is important for proper clutch operation and avoiding interference between the flywheel and the inside of the bellhousing, the motor shaft and the mainshaft, or with the profile plate itself.

The process of locating the flywheel exactly the "magic distance" from the profile plate starts with a sectioned side view drawing of the flywheel. With the shape of the flywheel defined, the design of the hub, which connects the flywheel to the motor shaft, is started.

Hubs

The hub has either a locating outside diameter that fits into a recess in the back of the flywheel, or a projection that locates the flywheel through the hole in the center. The job of this recess or projection is to hold the flywheel in perfect alignment with the centerline of the motor shaft.

The hub also has the holes for the original flywheel bolts in the correct diameter bolt circle and pattern. Provision is made for a mainshaft pilot bearing or bushing if the car requires it. All these items added together give us the hub, which is an exact copy of the original crankshaft end.

There are two different schools of thought on how to hold the hub on the motor shaft in the required location to maintain the "magic distance".

One method is to simply bore a hole in the hub that is a medium slip-fit on the motor shaft, and broach a key slot in it to match the key slot on the motor shaft. The hub is then placed on the motor shaft in its correct position and secured with setscrews.

This method is cheap and easy as machine work goes, but can create problems if the setscrews work loose in operation, which they too frequently do. If the hub moves back and forth along the motor shaft when the clutch is applied and released, the clutch operation and interference problems that were mentioned above can occur.

In addition, any looseness between the hub and the key that locks the hub in radial position on the motor shaft will lead to a type of failure called "postholing", which will damage both the hub and the motor shaft. The few dollars saved by the cheaper hub design might lead to an expensive failure later.

John Wasylina, an early EV pioneer and long-time member of the EAA, developed the second method of securing the adaptor hub to the motor shaft. John's "taperlock" hub is a two piece assembly.

The first part is the same as the hub described above, with two additions. The first change is a ring of four to six holes drilled and counterbored in the flywheel end of the hub. The diameter of the bolt circle of this ring is smaller than the flywheel bolt circle and is concentric to it.

At the opposite end of the hub, a large tapered hole is bored instead of a straight-sided slip fit hole. The depth of the hole and the degree of the taper matches the length, degree of taper, and end diameters of the bushing, which is the second part of the "taperlock" hub.

The tapered bushing is a short piece of steel with ends of different diameters. A hole the size of the motor shaft runs through it from one end to the other, and a keyway is cut the length of the hole. On the side of the bushing opposite the keyway, a narrow slit is cut through the bushing for its entire length.

Starting on the small diameter end of the bushing, from four to six holes are drilled through the length of the bushing using the same spacing and bolt circle diameter as the

small holes drilled in the hub. The holes are then tapped to suit the cap screws that the hub was drilled and counterbored for.

The hub/bushing assembly is installed on the motor in the following sequence. First, the bushing is slipped over the motor shaft and key. Next the hub is installed over the bushing and the counterbored holes in the hub are lined up with the threaded holes in the bushing. Then the cap screws are inserted through the holes in the hub and threaded into the bushing.

As the screws are tightened, the bushing is pulled into the hub, and the action of the matching tapers causes the slit to be squeezed closed, locking the bushing to the motor shaft, and at the same time locking the tapered surfaces of the hub and bushing together. After the screws are tightened to a little more than hand tight, the hub/bushing assembly can be removed only with a heavy-duty puller, or by hammering on the loosened cap screws to break the taperlock.

The advantage of the taperlock hub is its ability to lock on a motor shaft and not move under load. The only disadvantages are the more expensive hub assembly and a longer hub to provide a place for the bushing to live. These disadvantages are far out weighed by the knowledge that the vital part buried in the very center of your electric drive system will stay where you put it.

Motor Spacer Ring

The motor ring is the third part of the adaptor assembly and, like the profile plate and hub/bushing assembly, it has more than one job to do. The ring is a round piece of aluminum the same diameter as the motor it is being bolted to. It has a locating projection or recessed diameter that matches a recess or projection on the motor and a locating projection that matches a recess on the profile plate.

These recesses and locating projections are provided to assure that the centerline of the motor shaft and the centerline of the transmission mainshaft are in perfect alignment. There are four or more through holes counterbored to suit the cap screws that hold the ring to the motor. There are also four threaded holes for the bolts that hold the profile plate to the ring.

The second job of the motor ring is that of a precision spacer. Since it is easier, and therefore cheaper, to cut a complex shape like a profile plate out of thin material (5/8" minimum), using a spacer ring to fill the space between the motor and the profile plate is a good economical move. The amount of space that needs to be filled varies with the lengths of the hub, motor shaft, mainshaft, and the "magic distance" between the flywheel and the profile plate. It is much cheaper and more practical to machine a nice round 9" diameter ring that is 2 ¾" thick than it is to make a complicated 24" diameter profile plate that thick.

As you can see, the design and fabrication of a proper adaptor is a complex operation requiring a good deal of precision. For this reason, unless you have professional level skills in these areas, this is a job best left to those who do.

Luckily, writing this column doesn't require the same precise measurements. Since I underestimated the amount of material I had to discuss vs. the space available, I'm going to stop here and get into the actual installation of the adaptor on the motor, mating the motor/adaptor to the transmission, and installing that assembly into the car or truck next issue.

If you are interested in a closer look at adaptor design, email me at electro@cruzio.com and I'll email you an article I wrote on that subject for Home Power magazine. I can send it as either a text only file or in an Adobe Acrobat file.

Michael Brown is chronicaling the various stages of the ICE to EV conversion process. This is the 5th thus far in the series. As founder of Electro Automotive, he has many years of hands-on professional experience in the automotive industry, working with both ordinary family cars and race cars.

by Rich Rudman, copywrite 2001

Well what can I say, I am sunburned, I have a sore throat from trying to out talk Wayland.. and getting drowned out of the drags Friday at Mission. It was a adventure, another Plasmaboy/Madman production. First he calls me Friday morning, and gets me out of the shower... "Hey Madamn, I am picking up Rich Brown right now at the airport" . Oh good he's on time for a change... Cool "Call me when you actually get the cars north of the Columbia River. Hey I have to get Goldie bolted to the Ranger, get the Minibike from hell on board and the Genset, and the ..... ETC. At 11am I do lunch with my wife at the Ferry dock, climb on board, and Where the heck is John it's Noon? Oh He's in Woodland, and I am in the middle of Puget Sound, OH...he's 2 hours south.....Well that's still good for John, it's the same day. I blaze for Belligham, A run that was a commute for me last year. I still have some Buddies up there from the early DCP days. And they are drooling to play with my new toys and to see the rest of the EV crowd. Dean Tryon was a QC guy, and help Damon big time in the first 2 years of the Garage site. He's got a Jet electric that at 96 volts with a Raptor 1200 is just a sweat commuter. I was impressed, AND his sub woofers were larger than Johns. Well they looked it to me. So...

At 2:07 PM I was in the Alpha parking lot. 7 Minutes from ZEROing my ETA. I get a nice tour of LOTS of REAL power electronics and more AGM batteries than I could drool over. Alpha is Johnson controls largest single customer. Dean and I piled into the Jet Escort and went over to See Rich Csuk, the other DCP ex employee, and Well he has a Calculus final this week and needs

to cram, and can't blow off Friday afternoon for EV racing, Oh well it would have been fun But.... Ok now it 4pm, and Where's Wayland the gates at Mission just opened and we are about 1 hour away in the wrong country.

Cellphone time... OH great John needed some food and they are in Marysville, eating. GROAN!! Dean heads up the Guide with Goldie, and I in close pursuit, We drop off the the trusty commuter and head back to the MikeyD's in Lyden. And Wait for the Wayland and CO. and of course fill up on grease for dinner.

They blew right past us... and we caught them at the border. Well do we go racing since it's 5:30 and it looks like rain, or just head back and call it a night. We took the challenge of being late and racing the rain. We did find the Race tack after a short...tour in through a Mall but we made it. They were nice enough to Comp us and we all got pink run cards for special treatment. THEN CAME TECH... These inspectors had never seen a electric racer, and well they did it by the book. And we almost didn't make it. Uh Oh...I better gets some items cleared with Bill Dube. I found a 20-amp plugging in the tech area and proceeded to suck a nice topping charge, and then the rains came. BUMMMMER! They shut off the Clocks and sent us all home, John and I didn't even get to run. We got very wet and sticky, It was a hot summer night in B.C. Back down to Lynded we went in the pouring rain and spray. The driving was not fun, A few corners were missed In the dark, in the rain, but I got all my followers safe and sound if a bit grumpy back to the States and to couches and beds at Dean's place. END DAY One.

The weather Saturday morning was no better looking, but we are EVers we do it rain or shine. Off we went back up North, and Thank God the skyies cleared and things warmed up. We made to the right place without any missteps, but hauling trailer of EV through Vancouver can be a bit touchy. We made it.

With Goldie off the hitch The smoke show started. Only to be cancelled right quickly. There was a few serious Environmental groups there, and we had to Ummm be a bit more polite this year than last. Then just as I was told this, Plasma Boy lit up the White Zombie... and Smoked them real hard. Whoa John!!! NNO no down boy! Oppps ! We parked then for a while and got into the hand shaking mode and seeing old friends. Man I love this event, Warm friendly and no real nasty cutthroat competition, Just fun.

Then the Minibike came out. My first Ac toy. Dean got it down and fixed the throttle cable, and off he went. It goes pretty good. Then it was my turn, by that time all had noticed Rich's science project on wheels. After a few quick shots weaving in and out of the E-bike crowd, A few came over and took a look at the motor... THEN, then got impressed. Nobody had seen a 5 hp motor that is six inches in Diameter and 1 inch thick. I apologized that it was about at 1/2 the Snort that I could get and promised more at Woodburn. Then Wayland got to drive it, and we could find a E-bike or scooter that could keep up. Wow that much go from that small a motor! Then Dave Cloud challenged be in his not very slow 275 amp three-wheeler. I thought Oh OOh, I am going to get my but stomped. DC vs BLDC, TORQUE, vs encoders and amps and Neo magnets. Dave rarely looses ANY race with any EVs. We line them up and He made darn sure my Ac wonder was completely stopped, it's poorest power point. Then he hit go, I watch as his Permag Dc motor quickly spun it's front tire, and I twisted on my amps, and well it almost does wheelies, and very quickly jumped ahead of Dave, and Kept ahead, until we ran out of clear area, and the comcrete walls of Death loomed. Darn If Ac hadn't just kicked DC's Butt and done it in front of alot of EVers. COOL! Dave didn't know that I had 48 volts and 175 amps on tap, and the really tight airgap rotor. I did notice he had a 275 amp Curtis, They like to Bog at the start, Well Mine didn't bog!!!!. We did it again, a I still won, Dave said he was going to "Rewire it and try again", that sounded like contactor time... See ya! He didn't do it, but he has a good respect for BLDC now. Man I am going to have fun with this!! I don't know how many charge cycles the bike got But I need to get a larger 48 volt charger for it. I don't like to wait for this much fun.

We did the parade Minibike and Dean in Goldie, then they cleared the track and I took over Goldie for the White Zombie and Goldie Smoke show. Now Goldie doesn't do as good a show as in past years, because I have a really tight suspension and 5 batteries over the front rubber. She launches alot better, but I can't holde her back with the E-brake. John drops the hammer on his zilla and What the motors groan, and the tires bite in hard but no smoke??? Is it that much warmer than it was when we got here??? He can's spin his sticky Nittos, Wow!! Goldie lifts the front street rubber and says SEEE ya! I blast around the track side ways on the firm Britsh struts and springs. And.. What John is still in the front strech? Still not a good sight, and it looks like his line lock won't unlock, and he almost hits the wall. What the heck??? there is so much torque that the Zombie lifts the drivers front tire, even though it's locked up, and the right side digs in locked up, the car is squirming to the right but the front won't let go. I raced back to my tool box and got a brake line wrench, we bled the line Pressure and he limped it back to the pits.

So.... Goldie beat the Zombie in the smoke show... John was NOT amused. I don't expect to get this lucky again for quite awhile.

It was a nice warm day, we all had lots of fun. Thanks much the VEVA folks who invited us and put on such a wonderful show. Thanks to the Storm Brewery for the free Beer, it gets better ever year, the steaks that Bary Blidook barbied up. Thanks to Dean Tryon who put us up at his house. Madman,Plasma Boy and Rich Brown and Bruce Meyland, are quite a house full.

Rich Rudman
Madman Manzanita Micro

Rich's Goldie on left, John's Zombie above.

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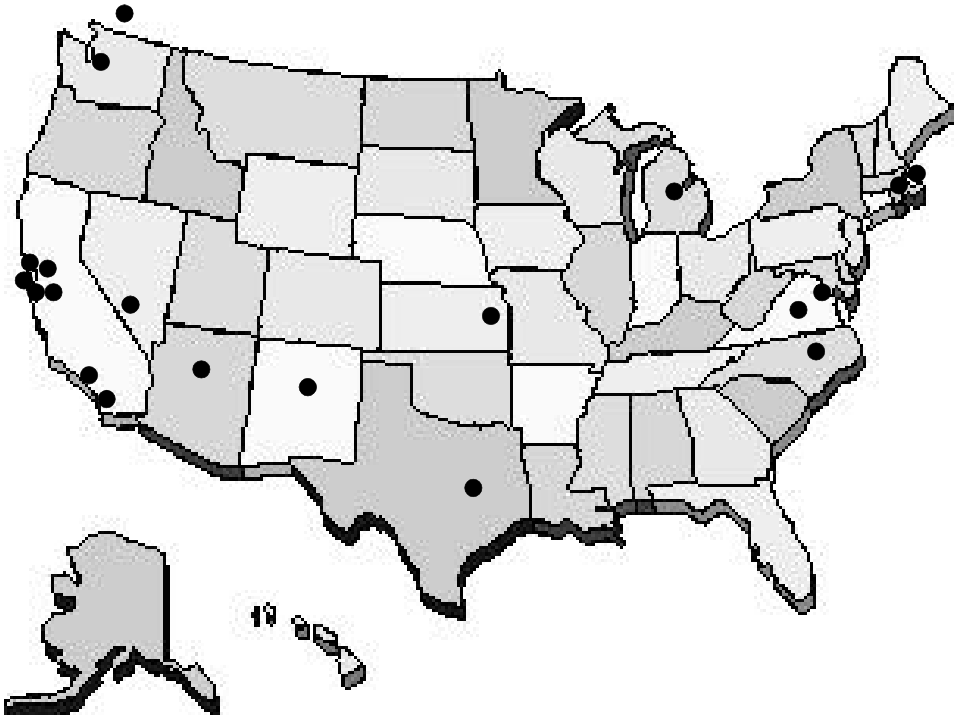

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Meetings: Call for details.

WASHINGTON D.C.
ELECTRIC VEHICLE ASSOCIATION OF WASHINGTON DC
Web Site: http://www.evadc.org
Contact: David Goldstein, Chapter Pres., goldie.ev1@juno.com
Meetings: 2nd or 3rd Tuesday/month, 7 pm
Location: National Institute of Health (NIH), Building 31-C, 6th Floor, Bethesda, MD.
Note: Please call Charlie Garlow 1-202-564-1088 to confirm attendence.

Listing updated, verified and current as of 7/15/01.

Encourage other EV groups to become affiliated with the EAA. Contact the Board or check out the Board webpage for information.

Board of Directors 2001

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Ron Freund
rfreund@hpchs.cup.hp.com

Vice-Chairman
EAA Membership
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willbeckett@email.com
1-650-494-6922

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Cars for *Clean Air*
Kurt Bohan
eaanews@aol.com

(new appointment)
contact
tbd

EAA Board contact:
e-mail: EAA-contact@excite.com
phone: 1-510-864-0662

EAA Membership contact:
e-mail: EAAmembership@email.com
phone: 1-650-494-6922

July 15-25

American Solar Challenge, Chicago, Illinois to Los Angeles, California, USA
Teams from around the world will participate in this 2300 mile solar car race from Chicago to Los Angeles.
Website: http://formulasun.org/asc/

August 6 - 10

2001 Management Briefing Seminars, Traverse City, Michigan, USA
Annual management briefings on automotive industry and transportation issues sponsored by Environmental Research Institute of Michigan Center for Professional Development, University of Michigan College of Engineering
Contact: ERIM
Phone: 1-734-662-1287 x946
Fax: 1-734-662-5736
Website: http://www.erim.org

August 25

EBEAA EV Rally, Walnut Creek, California, USA
Fifth Annual EBEAA Annual Rally for distance and performance.
Phone: 1-925-685-7580
*Website:*http://www.geocities.com/MotorCity/1756/

August 25

Woodburn Electric Car Drag Races, Wodburn Dragstrip, Woodburn, Oregon, USA
Phone: 1-503-982-4461
Web Site: http://www.woodburndragstrip.com/

September 9 - 14

Hypothesis IV, Stralsund, Germany
Conference on theoretical and engineering solutions on hydrogen power. It will cover all aspects of technology developments and commercialization of hydrogen and fuel cells.
Contact: Fachhochschule Stralsund University
Phone: +49-3831-456-811/456-703
Fax: +49-3831-456-687
E-mail: hypothesis@fh-stralsund.de
Website: http://www.hypothesis.de

September 15

SVEAA Chapter Rally, Stanford, California, USA
Annual Silicon Valley EAA Rally, from 10 am to 4 pm, at the Stanford University Campus.
E-mail: Will Beckett@email.com
*Website:*http://home.pacbell.net/beckettw/rallyinfo.htm

September 29

Sacramento Races, Sacramento Raceway, Sacramento, California, USA

October 1 - 4

SAE Automotive and Transportation Technology Congress and Expo (formerly ISATA), Barcelona, Spain
Conference to explore issues, products and ideas vital to the automotive and transportation technology industry.
Contact: ATT staff
Phone: +44-1372-720620
Fax: +44-1372-720101
E-mail: enquiries@attce.com
Web Site: http://www.attce.com

October 20 - 24

EVS-18, Berlin, Germany.
Eighteenth annual EVS International Electric Vehicle Symposium , hosted by EVAA.
Contact: EVAA
Phone: 1-415-249-2690
Fax: 1-415-249-2699
E-mail: ev@evaa.org
Web Site: http://evs18.tu-berlin.de/

November 5-8, 2001

SAMPE, Seattle, Washington
33rd International Society for the Advancement of Material and Process Engineering, Technical Conference
*Web Site:*http://www.sampe.org/eventsi.html

Sparrow:

The vision of where this industry is headed is the Personal Electric Vehicle (PEV). Think of it as a one-person electric car. They're clean, quiet, and efficient. Like a car, PEVs provide the user with point-to-point transportation. Designed for one person and a small amount of cargo, their range, speed, and cost are moderate. The Sparrow is the premier example of a PEV. It's a three-wheeled electric vehicle: two wheels up front, one behind. Designed from the ground up, it takes you 40 miles at 60 mph.

Price: $15,000.

Specifications:

- 156 volts DC (Thirteen 12-volt batteries in series)
- Three wheeled vehicle registers and insures as a motorcycle
- 1350 pounds curb weight (approx. 612 kg)
- 61 inch (155 cm) wheelbase
- 57 inch (145 cm) vehicle height
- Top speed: 70 mph (110 kph)
- Range: 30-60 miles (65-97 km)

Sparrow EV Driver/User's Page: www.geocities.com/sparrow_ev

Corbin-Pacific Inc., 2360 Technology Way, Hollister, CA. 95023
Phone: 408-634-1100
Fax: 408-634-1059

http://www.corbinmotors.com/

In recent years there have been many new multi-manufacturer arrangements, which have made it difficult to delineate individual companies. For example:

- Ford fully owns Volvo and Jaguar, and partially owns Mazda
- General Motors fully owns Saab, and partially owns Suzuki and Subaru
- DaimlerChrysler partially owns Mitsubishi and Hyundai
- Nissan is fully owned by Renault
- Volkswagen fully owns Rolls Royce
- Kia is partially owned by Hyundai, Ford, and Mazda

Solectria and Sparrow are the only EVs you can buy , other than conversions.

Here's a view of some Honda EVplus gatherings and the GM EV1 launch - what a sight!

Sources for Existing EVs for Sale:

Silicon Valley Chapter EAA
http://home.pacbell.net/beckettw/forsale.htm#owned

Innevations
http://www.innevations.com/used-evs.html

Eco-Motion Electric Cars
http://www.halcyon.com/slough/contributions.html

Arcata Electric Car
http://www.tidepool.com/~ecar/list.html

EV Tradin' Post
http://members.nbci.com/evalbum/geobook.html

EVA/DC
http://www.evadc.org/forsale.html

Triangle EAA
http://www.rtpnet.org/~teaa/forsale.html

1979 four-door VW Rabbit for sale: converted by Electro Automotive for current customer in 1993, using the Voltsrabbit Kit. It has:

8" ADC motor
Curtis/PMC 1221 controller
Sevcon DC/DC converter
K&W onboard charger
Welded steel/powdercoated battery racks
Welded polypropylene battery box in hatchback (batteries under hood in open racks)
Power brake booster system
Custom springs, heavy duty shocks
16 US Battery 125 batteries, about 3 years old, still going strong
12V auxiliary battery is 1 1/2 years old

Car has 95,819 miles total, about 15,000 miles electric. Located in Oakland, CA, and has been regularly driven up a couple of good hills. Selling to reduce the household fleet from two cars to one. Asking $6,000 or best offer. (For reference, this kit currently sells for $7,950, without batteries.)

Contact Margaret Elizares at 510-562-2517. Has complete documentation on the car, including a faithful driving log.

Electric Auto Association (EAA) Membership Application Form

Print and fill out this form, attach a check or money order in US funds only for $39 ($42 Canada) ($45 International) payable to 'Electric Auto Association'. You can fold this form as indicated and mail it with your payment enclosed. Do Not use staples. Use tape to attach your payment, and seal the form before you mail it.

New Member: ___ Renewal: ___ Country origin: _____ Date: _____

Name & *email: _____

Home & Work phone # _____

Street, City, State & ZIP: _____

Referred by:

I support the _____ EAA Chapter (*optional)

(fold back ward, this will protect your personal information, placing it on the inside)

The Electric Auto Association www.eaaev.org

'Providing free Electric Vehicle information to the public since 1967'

The Electric Auto Association (EAA) is a non-profit organization (eaaev.org 501c3) for the promotion of Electric Vehicle use in and by the public. Your membership is Tax Deductible and you will receive the informative monthly EAA publication, "Current EVents". All information and statistics in this application are for the exclusive use of the EAA and is not sold or given to any other organization or company. From your membership dues, a percentage goes to the EAA Chapter you support for public Electric Vehicle promotion activities like EVents, Rallies, Shows, and EV rides.

(fold the bottom half under. This will now be the front of the letter. Be sure to seal it with tape)

Return address

_____

_____

_____

1st Class Postage Here

Electric Auto Association
Membership, 4189 Baker Ave.
Palo Alto, CA 94306-3908 USA

EAA Merchandise

The **Electric Auto Association** (EAA) is a nonprofit organization for the promotion of public awareness of Electric Vehicle use as a viable transportation option. All minor sales proceeds are used to cover the costs of our nonprofit efforts in this cause. Please show your support with your purchases for better, cleaner, quieter, and lower maintenance transportation.

Product	Description	Comments	Item#	Price
Licence Plate Holder	Black plastic frame, white lettering on visible green.	Allow 6 weeks.	LICPH1	$ 10.00
Licence Plate Holder	For motorcycles. Black or chrome metal.		LICPH2	$ 14.00
Embroidered Patch	White, Sew-On.	Allow 3 weeks.	PATCH1	$ 6.50
Embroidered Patch	Green, Sew-On.		PATCH2	$ 6.50
Embrodered Hat	Adjustable fit.		CAP002	$ 9.50
"Electric Vehicle Parking Only" Sign	Metal sign, reflective white background with dark green lettering. Wall or pole mounting.	Like public no-parking sign quality.	PARK01	$ 25.00
EAA Key Chain	With LED light and "30 years 1967-1997".		KEY01	$ 2.50
Coffee Mug	Ceramic.		MUG03	$ 5.50
Insulated Car Coffee Mug	Plastic.		MUG02	$ 6.50
Embroidered Polo Shirt	Size: S,M,L,XL,XXL. Color: Forest, Teal, or Navy.	Allow 10 weeks.	SHIRT01	$ 30.00
EAA Jacket	Size: S,M,L,XL,XXL. Color: Blue or Black.	Allow 10 weeks.	JACKE1	$ 59.00
EAA Wind Breaker	Size: S,M,L,XL,XXL. Color: Blue or Black.	Allow 10 weeks.	WBREK1	$ 49.00
EAA Sweat Shirt	Size: S,M,L,XL,XXL. Color: Blue or Black.	Allow 10 weeks.	SWEAT1	$ 39.00
EAA ball-point pen	EAA ball-point pen with EAA.	Sold individually.	PEN01	$ 1.00
Car Window Shade	EAA Car Window Shade.		SS001	$ 8.00
Bumper Sticker #1	EAA Bumper Sticker.	Size: 10.5" x 3.75"	BS800	$ 2.00
Bumper Sticker #2	EAA Bumper Sticker "The Switch is on".	Size: 15" x 3.75"	BS002	$ 2.00
Decal	EAA Decal (The Switch is on).		DECAL	$ 1.00
	— EV Buyers Guides —			
2000	Electrifying Times Preview 2002.		BG2000	$ 5.95
1999	Electrifying Times	Not available.	BG1999	NA
1998	Electrifying Times Preview 2000.		BG1998	$ 5.95
1997	1997 EV Buyers Guide.		BG1997	$ 5.95
1996	1996 EV Buyers Guide.		BG1996	$ 5.95
1995	1995 EV Buyers Guide.		BG1995	$ 5.95
	— Literature —			
Convert-It	EV conversion Book		CONV01	$ 24.95
KTA Catalog	Electric Vehicle Kits & Component Parts		CATAL1	$ 5.00
Window Literature Holder	Light plastic.		WL002	$ 15.00
	— Special —			
AVCON to 14-50 Electrical Adapter Kit	Sheet metal box, 14-50 outlet (2 hots and a ground, no neutral), for 220 VAC chargers only.	Allow 6+ weeks delivery after payment deposited. Some assembly required.	ADAPT1	$200.00
EAA Membership	Fill out Membership for on opposite page	Include form w/ order.	EAAM01	$ 39.00
Shipping	US =10% / CANADA =15%, OTHER = 20% of the sub-total.	*Orders are restricted to the US, Mexico and Canada*	Subtotal Shipping	$_____ $_____
			Handling	$ 2.00
			TOTAL	$_____

To order, include your name, phone number, mailing/shipping address and payment by check or money order. Please specify quantity for each item and size/color for clothing.

Send orders to:

EAA Store, 5820 Herma St., San Jose, CA 95123-3410

ELECTRIC AUTO ASSOCIATION
2 Smith Ct, Alameda, CA 94502-7786

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