

SHIRL DICKEY ENTERPRISES

Home of the 'E-RACER'

P.O. Box 4022
Sedona, Arizona
(602) 567-6333

Dear Homebuilt Aircraft Enthusiast:

Thanks for your interest in the E-Racer homebuilt aircraft. I would like to present some observations about aircraft offered to the homebuilt industry and how the E-Racer measures up to this competition..

#1--Aircraft Safety: If you attempted to identify the safest A/C in the industry, you would probably start by eliminating all designs with dangerous stall/spin characteristics. Next, you would eliminate all designs that can stall--after all, if it won't stall, it can't spin. 50% of A/C fatalities involve some form of stall/spin accident. Of the designs that have not been eliminated so far, the canard types, by far, make up the majority.

The next most dangerous aspect is post-crash fires. Composite A/C have consistently demonstrated that they do not burn on impact, while metal A/C do. Why? Composite A/C do not provide sparks during breakup as an ignition source.

So you're down to a composite canard design. Some improperly designed canards suffer a phenomenon called "deep stall". This is evidenced with canard designs with either too much canard area, too much strake area, or both. Deep stall can also be induced by flying a Canard type aft of its aft C.G. limit. The Velocity suffers from both too much canard area and too much strake area, and that design is particularly susceptible to deep stall. The Cozy's (III & IV) have smaller canard and strake area, and are probably less susceptible to deep stall. Both of these designs suffer from a C.G. management problem that requires the pilot to carry approximately 50# of ballast that must be shifted around the airframe to maintain the A/C within the C.G. envelope (One pilot, no passenger - ballast must be moved forward, pilot and passenger up front, ballast must be moved aft). Forget to do this, and they find themselves flying aft of the aft limit, and are exposed to the third dangerous characteristic. Conclusion--eliminate all designs that are susceptible to deep stall and all designs that require ballast shifting to maintain the A/C within limits.

You are now down to two A/C...the original Long EZ and the E-Racer. Both A/C have properly designed canards, and the E-Racer has even smaller strakes than the Long EZ. The E-Racer does not require any re-ballasting to remain within C.G. limits. This is because the cockpit was moved aft 10" from the original LEZ location. This reduces the moment arm and allows a shift of up to 180# in the front seats and still be within the C.G. envelope. This is enough (in most cases) to allow the A/C to be flown solo (near the aft limit), and then board a 180# passenger and still be within the forward C.G. limit. Thus, the A/C can be flown solo or two-up without regard to C.G. shifts, except in the most extreme cases. Couple these advantages with the forward-tilting canopy which can be opened in flight without destabilizing the A/C allowing the cockpit to be cleared of smoke should the occasion arise, and I think you must conclude that the E-Racer is probably the safest home-built A/C on the market today.

#2--Construction difficulty: The composite designs, and particularly those using the moldless construction method are by far the easiest to construct. No special tools or skills are required. Mistakes are easy to repair. Drill a hole in the wrong place in a metal A/C and you scrap the part. In a composite structure, you can repair such a mistake with a patch (except in spars and shear webs); the only consequence being a little weight increase. The first plans-built E-Racer has flown (in December, '92), and the builder is retired and nearing 70 years of age. He also conducted his own first flight. I also have several other retirees nearing completion on E-Racers. A further testament to the ease of construction are the thousands of Vari Eze's and Long EZ's that have been built and flown mostly by first-time builders using the same composite construction methods as the E-Racer. My recommendation for a first-time E-Racer builder would be to stick with A/C power (MK-II), as it is a less complicated A/C. Considering the additional baggage and utility, it may be the best all-around configuration, anyway.

#3--Level of skill to fly: Any of the Rutan-style canards are extremely easy to fly. The flying qualities of the E-Racer are delightfully easy. Crosswind landing capability is extremely good, and it does not require precise approach speeds. At any approach speed from 75 to 100 mph, the A/C just plants itself on the runway with no tendency to balloon. It is a retractable A/C, and as such, requires the pilot to extend the gear on landing. It does not require the additional complexity of flaps or speed brakes; therefore, the E-Racer is no more complicated to land than a Cessna 172.

Shirl Dickey

I

January 21, 1988

E-Racer Information and Data
by;

Sierra Delta Systems
1702 W. McNair St.
Chandler, AZ 85224

The E-Racer is a high performance two place, cross country aircraft. It is unique in that it uses an automotive V-8 engine for power. The E-Racer was designed around the popular Long EZ airframe, but was modified to incorporate some features that were not available in the Long EZ design. The major differences are as follows:

1. Side by side seating.
2. Fully retractable landing gear.
3. Automotive power with gear reduction.

The E-Racer uses Long EZ wings with several small modifications to improve strength, aesthetics and performance. These modifications included increasing the structural strength by more than 25% by beefing up the spar caps and shear webs. I also changed the trailing edge to be straight from tip to root. This corrected a slight kink just inboard of the aileron that exists on the Long EZ. It was put there in the early development of the Long EZ to match existing cowlings. At present the prototype E-Racer uses the same airfoils as the Long EZ. No changes were made to the sweep, cord, taper, washout or wing attach fittings. This makes it possible for an E-Racer builder to retrofit Long EZ wings to an E-Racer fuselage if he so desired. The only limitation would be to limit such a project to 1800 lbs. gross weight. I also repositioned the winglets on the E-Racer by moving them forward to line up the leading edge of the winglet with the leading edge of the wing. I believe that the position of the Long EZ winglet was also a compromise made during the design phase to make room for the original wide cord rudders. These rudders were found to be deficient and were subsequently replaced with the high performance, narrow cord rudders. The relocated winglet on the E-Racer results in a stronger winglet to wing joint that is four inches wider than the Long EZ joint. The last modification made to the wing assembly was to eliminate the lower stub winglets. I did this to reduce drag. This item was placed on the wing to act as an anti skid skag to prevent damage in case of touching a wing on take off or landing. As mentioned above, standard Long EZ wings could be used on an E-Racer and so all of these modifications could be considered optional although I would like to see plans built E-Racers built just like the prototype.

The canard used on the E-Racer is the Roncz 1145 MS,

currently offered as an option on the Long EZ. This canard is immune to rain trim changes and bug contamination effects. It is also a more powerful airfoil which allows it to have less span than the original GU airfoil and this contributes to lower drag and higher performance. To use this canard on the E-Racer required that it be widened by seventeen inches. This worked out nicely since all of the hinge points and hardware corresponded with the left elevator of the Long EZ. To say it in another way, both of the E-Racer elevators have the same hinge point position and tube length as the left elevator of a Long EZ. The two E-Racer elevators meet at the center console control stick. This arrangement results in a canard with five inches more of exposed span than the Long EZ has.

All dimensional relationships between the Long EZ canard and the wings were maintained on the E-Racer. This puts the C.G. envelope of the E-Racer in the same location as the Long EZ. In order to achieve the proper C.G. on the E-Racer after locating the automotive V-8 engine ahead of the main spar, it was necessary to relocate the cockpit aft ten inches. This in conjunction with the placement of the reduction box, starter, alternator, battery and radiators aft of the main spar resulted in the C.G. of the E-Racer in the same position as with the Long EZ. The result of this arrangement was to improve the aesthetics and aerodynamics of the fuselage and simplify the engine conversion by eliminating the need to integrate the engine and gear box into one unit.

The engine used in the prototype started out as a 1963 aluminum Buick, 215 cu. in. V-8. Very few of the original "215" engine parts were actually used. Only the aluminum block, oil pan and intake manifold remain from the original engine. It now has a Buick 300 crankshaft, modified to fit in the block. This crank increases the stroke from 2.80 in. to 3.40 in. It uses early Chevrolet 327 rods narrowed to fit the Buick rod journals. Pistons are .030 in. oversize forged aluminum units specified for a Vega. The engine displacement is now 266 cid with these parts. It uses Buick 300 heads. These are 1964 units, the only Buick 300 heads that were aluminum. The camshaft selected is a re-ground Buick 300 cam of moderate specs. I have a more radical one on the shelf by Crower that I may try if more power is required. The front cover is also from the Buick 300 and the ignition is a dual point, all centrifugal Mallory unit. It also has a high capacity Melling oil pump and modified oiling system. The modifications made to the engine were intended to increase power and reliability without exceeding the original RPM limit of 5000 RPM. The exhaust system is currently eight short, straight stacks. This is not as efficient as a tuned exhaust system, but it does not have the problems of weight and complexity that a tuned system would have. All of these modifications should result in about 250 horsepower at 5000 RPM.

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The engine that I have built up should do a good job in the E-Racer, especially at a weight of only 285 lbs. However, almost any of the new light weight four, V-6 or V-8 automotive engines could be used in the E-Racer. The airframe should not be subjected to any more than 300 HP in order to avoid problems of high dynamic pressures and flutter which the airframe is not designed to handle. The mid-engine design allows a wide range of engine selections with out the need to ballast for different engine weights. Only the empty weight of the airplane is effected by engine selection. Builders should be aware that low weight and reliability are the prime requirements when selecting an engine for an E-Racer, not just high horsepower. Keep in mind that the side by side configuration has been proven as a viable configuration by the Cozy and it does it on only 118 HP.

An E-Racer builder should identify his own individual requirements for an airplane before selecting the engine. If high speed is important, then up to 300 HP will allow a cruise near 300 MPH at the expense of fuel economy and payload. If baggage and economy are important then a small four cylinder engine (like an Oldsmobile Quad Four) in the 150 HP range might be a better choice since the narrow four would allow substantial volume for baggage along side of the engine. The engine choices available will dictate the ultimate utility of the airplane. The nice thing about an E-Racer is that there is so much flexibility in this selection. Keep in mind though that you can't ^{have} everything in one airframe. One important thing to remember when selecting your engine is that the reduction box has a maximum reduction ratio of 2:1. This means that your engine must develop its power at or below 6000 RPM. Personally, I would not like to fly cross country with my engine running continuously at 6000 RPM. This would be equivalent to running your car at over 100 MPH for hours at a time. Your engine just would not stand up to that kind of abuse. I plan to fly at a maximum continuous engine speed of 4400 RPM in the prototype E-Racer, short bursts to 5000 RPM may be acceptable to impress friends. I currently have a 1.75:1 gear ratio installed in the reduction box.

Engine cooling is achieved with two harrison heat exchangers taken from a Buick air conditioner system. These are all aluminum units that weigh only four and a half pounds each. The measure 10 X 14 X 4 and I have located them below and aft of the main spar, under the drive shaft. They are fed by a large NACA flush scoop located on the belly of the fuselage. The throat opening is 5 X 14 inches. Cooling air passes through the radiators and is then pulled out through an opening at the prop hub by the prop. The system is designed so that when the engine is shut down, natural convection will continue to circulate air through the radiators and carry heat away from the cooling system. I also have small NACA scoops located under the strakes on each side of the fuselage which wash the engine compartment and exhaust system with cooling air while in flight. This

carries away unwanted heat and keeps the engine compartment cool. The cooling system will also provide cabin heat from a small automotive style heater core located in the forward foot well. Temperature in the cabin will be controlled by varying the air flow and coolant flow to the heater core, just like you do it in your car.

The landing gear is fully retractable. The main gear is hydraulically actuated and fold upward and outward into the strakes. The nose gear is electrically retracted. The retractable main gear will provide a significant reduction of the total airframe drag and adds to the aesthetics of the airplane in flight, but at a cost. In this case at the expense of some fuel capacity. The E-Racer has an estimated range of 1000 statute miles, on 46 gallons of fuel and 65% power. On a long cross country a Long EZ might beat an E-Racer because of fewer fuel stops. Something to think about. I plan to replace the electric nose gear motor with a hydraulic actuator tied into the main gear system. This will allow me to deploy and retract all three gear with just one system. At present I must deploy the nose gear and the main gear separately, which is definitely not good from a procedural stand point. I am using Lamb tires because of volume limitations in the strake wheel wells. I still require small aerodynamic bumps on the upper and lower surfaces to fully enclose the wheels. Larger tires such as the standard 500 X 5 could be used but would require even larger fairings. The aerodynamic penalty for using the larger tires would be small however. The landing gear struts are laid up with multiple layers of unidirectional carbon fiber. Each gear leg weighs only 12 lbs. The retract linkage and hand pump weigh another seven pounds for a total gear weight of 31 lbs. This is within a few pounds of the Long EZ gear strut, and so the retract system does not require a significant increase in airframe weight. The hydraulic system is designed to fall freely to the down and locked position in case of a hydraulic fluid or pressure loss.

The cockpit has side by side seating and has the same incline and length as the Long EZ. Width at the shoulders is 42 inches and is very comfortable, even with two full sized adults. The control stick is located in the console between the seats. This results in the same right hand control for the pilot, seated in the left seat, as a Long EZ or Varieze. The copilot can take control of the aircraft with his left hand. I have installed a motorcycle style throttle on the control stick. It has a friction lock to hold its setting while normal stick motions are exercised during cruise flight. This results in equal access to the aircraft controls from either seat and gives simultaneous one hand control of pitch, roll and throttle. I really like to fly the airplane with this system and I recommend it to all E-Racer builders.

Access to the cockpit is provided by a forward tilting

canopy. The canopy tilts up 60 degrees to provide ample access. It is a smoke tinted Cozy transparency purchased from the Airplane Factory, in Dayton, Ohio. I also have installed a kick in step on each side of the fuselage to facilitate entry and egress. I chose the forward tilting canopy because I did not want passengers crawling over me during boarding operations which is sometimes required with a side tilting arrangement. With forward tilt, the cockpit can be entered from either side. The support system for the canopy uses two gas charged cylinders mounted behind the instrument panel, well out of the way. Two canopy supports mounted 14 inches apart provide the bearing pivot location and gas spring attachment points for the canopy frame. This results in a very stiff support structure. The canopy has a nice feel, it is rigid and the motion is smooth. I have also added an inner tube type valve to one of the gas cylinders that allows me to adjust its internal pressure so that the canopy will stay up.

I will be offering several prefabricated kits to support E-Racer builders. These will include a complete landing gear kit including the gear struts, the attach fittings, the retract linkage, actuators, selector valve and hand pump. I will also be supplying the gear reduction box and drive train components. Other items will be available from suppliers such as metal parts, linkages, controls, rudder pedals and a raw materials kit. Some suppliers have been identified and others are yet to be selected. These sources will be announced in the E-Racer newsletter.

Shirl Dickey
Sierra Delta Systems

Sierra Delta Systems
1702 W. McNair St.
Chandler, AZ 85224

St.

MOST FREQUENTLY ASKED QUESTIONS:

Q. Can I use a Mazda rotary engine in an E-Racer?

A. Due to the maximum gear ratio of 2:1 with the E-Racer reduction drive a rotary installation would be limited. However, with a smaller diameter prop and a rev limit of about 7000 RPM, a rotary installation might be feasible in the E-Racer.

Q. What is the front seat weight range?

A. The E-Racer will accommodate a minimum of 135 lbs and a maximum of 360 lbs in the front seat before exceeding C.G. limits.

Q. What is the maximum ceiling of the E-Racer?

A. With the power available an E-Racer with on board oxygen could exceed 30,000 ft without turbo charging. A variable pitch prop would allow the engine to attain its maximum RPM at altitude and hence maximize its available power for even higher altitudes.

Q. Does the side by side seating result in a large enough panel for an IFR installation?

A. This is easily possible, I have seen a full IFR panel in a Varieze, you just have to be a little creative.

Q. Is it possible to use the E-Racer retractable main gear in a Cozy, and if so will you make it available.

A. Yes, the retract system could be used on a Cozy, but there would be some compromises, such as reduced fuel capacity and the loss of some rear seat volume seven inches ahead of the center spar. If the demand for such a system is great enough, I will develop the option for Cozy builders. However, it will be in the form of a kit and not as a set of plans. I estimate that I could market such a kit for about \$1800.00.

Q. Can I use the E-Racer gear box for other aircraft, such as a scale P-39?

A. The E-Racer gear box is made to be an independent unit, separated from the engine and driven with a shaft. Any aircraft design that would use the gear box in this way would be a candidate for this unit. It would not be suitable to integrate this gear box and an engine into one unit. It is certainly strong enough to handle any automotive power plant.

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E-RACER NEWSLETTER NO. 11 FIRST QUARTER, 1989

Published quarterly by:

SIERRA DELTA SYSTEMS
1702 W. Mc NAIR
CHANDLER, AZ 85224
(602) 491-1548

It is mandatory that all E-Racer builders subscribe to this newsletter, as this is the only formal system I have to communicate information and updates to the builders.

The copying and re-distribution of this newsletter to other interested persons by subscribers is authorized and encouraged.

When writing to SDS with questions, please send along a stamped, self addressed envelope if you wish a personal reply. If you call, you can reach me in the evening between 7:00 pm and 9:00 pm at the above listed number. Please respect this call in time block.

The following prices are currently in effect as of the date of this newsletter:

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| Information kit..... | 9.00 |
| Newsletter..... | 12.00 |
| Plans, Airframe..... | 250.00 |
| Auto engine installation details.... | 150.00 |

I am now releasing plans on a limited basis to those builders who wish to build an E-Racer Mark II. (Aircraft engine version) This means that I am mailing out the first few chapters to plans purchasers upon receipt of the fee. Subsequent chapters are being sent out as they are completed. These plans are preliminary releases and are not the final version. I am doing this in order to make it possible for anxious builders to get started on their projects sooner than would be possible if they had to wait for the final plans package. The E-Racer Mark I (auto engine version) is still in the development phase and I will not release auto installation details until I am totally satisfied with its performance.

Sierra Delta Activities;

The last quarter has been dominated by the relocation of my

residence from the Mandan street address, where I had been renting for two years, to a home that I purchased in Chandler, AZ. This makes it possible for me to sink down some roots. At least now I can set up a shop in my garage and feel like I am once again making progress with my life. Home ownership makes this possible for me. This new location puts me closer to the Chandler Municipal Airport where the E-Racer is based. This will give me quicker access to the project and hopefully improve my productivity. I have been rather slow to complete the repairs to the prototype due in part to the move, but also contributing was my low level of motivation coupled with hot weather in Phoenix. I have been alternately involved in making molds for gear legs, making new landing gear for myself and other builders, plus the completion of three more chapters of the plans. The gear leg molds were completed in October and the first proof set of landing gear were produced. The new gear legs look very good but I grossly under estimated the labor content required to produce them. This has left me with a production problem. My solution for the time being is to hold the line on the price of the gear, but require the builder to complete some of the fabrication details himself. This will require the builder to complete the attach tabs for the retract linkage and to contour the axel pad to the correct shape. This is best done on the airplane anyway and will allow me to continue to provide landing gear at the original price.

With regard to the repair of the E-Racer, in the last five months I have completed approximately one third of the belly damage starting at the nose and complete back to the instrument panel (FS-50). I have installed the new two inch longer nose gear strut which will reduce my rotation speed at forward C.G. I also revised the nose wheel retract opening in the fuselage including the relocation of the nose wheel cover. I would like to include a retractable nose wheel door to reduce airframe drag but I don't want to get bogged down with unnecessary details and so I haven't yet decided to take the time and effort to do it. I have, as mentioned above, also completed a set of landing gear for the prototype which I have trial fitted into the airframe. I need to complete the belly repairs before the gear goes in for the last time.

I now have another unexpected problem that is slowing my progress, unseasonably cold weather. I cannot laminate below about 70 degrees and after waiting for cooler weather I find that I must now wait for it to warm up a bit in order to proceed with the repairs. This has also slowed progress on my production of landing gear. I am coming to the conclusion that I cannot do everything that needs to be done. I am considering either farming out the landing gear production or else hiring an employee to produce them for me. The added burden of supplying landing gear has taken a large chunk of my available time. The Sierra Delta operation demands my full time attention, but since

there is not enough revenue to support me on that basis I can only give it part of my time. I'm starting to feel like I am being driven by the project rather than the other way around.....

I am now investigating several alternates to the reduction drive that is currently in use in the prototype. These optional drive units are under study in order to expand my experience base with reduction drives. The adapted marine unit that I have used on all of my flights to date has proven to be very reliable over the short haul (approximately 100 hours of test and flight time). It is reasonably low in cost (approximately \$1800.00 as modified) and at 50 lbs it is within acceptable limits on weight. It has the additional benefit of a wide selection of drive ratios although this is not of great importance so long as the right ratio is available. Most automotive piston type applications will require a ratio of between 1.6 and 1.9 to one. These advantages were a powerful influence on my choice for a reduction unit when I started the project. After my 100 hours of experience I have only one complaint about the unit. Due to the constant mesh of the relatively large gear teeth there is a constant low level vibration that leaves me with an uneasy feeling in flight. This vibration is very slight and not noticed when first flying. After a time in the air on longer flights I began to analyze the sounds and feelings of the airplane and I become conscious of the gear box. It's subtle vibration is felt more than heard. I have traced it to the gear meshing frequency. I have taken many steps to reduce or eliminate this annoyance. I have mounted the box in rubber to isolate the vib's from the airframe. I have installed a vibration isolation device which was very good at eliminating 98% of previous harmonic vibrations. I have added a 15 lb. flywheel to the system which also helped the problem. The last bit of vibration is always the hardest to eliminate. I am contemplating the fabrication of a set of gears with many more, but smaller teeth. This would increase the number of teeth in contact at the interface and distribute the torque loads across more teeth reducing the gear stresses.

In the mean time I am investigating other reduction units in light of my needs and experience. The first unit that has me interested is a timing belt unit built by Tom McNeilly of Gilbert, AZ. He has designed a beautiful unit for low horsepower applications, up to about 150 HP. I have had several brainstorm sessions with him to determine if his unit could be scaled up to handle the horsepower that I need for the E-Racer. His unit can be expanded to a double belt system that gets me close to the rating that I need, but its not quite there yet. In order to get more capability we need to go to a larger tooth profile and this causes a giant leap in size and weight. It also causes me a problem with the center to center dimension between the input and out put shafts. The E-Racer prototype was designed with a 4.5 in

center to center distance. I can accommodate small deviations from this measurement but large changes are difficult to handle. A secondary problem for me is the prop rotation. A gear drive reverses the direction while a belt unit does not. This would require me to buy a new \$400.00 prop in order to try it out. The main benefits that a belt unit would impart are lighter weight, built in vibration isolation along with long term reliability assuming that one can be built with adequate safety margins.

Lou Ross of Tucson, AZ has two units that interest me. One is a pure planetary gear unit. It is constructed from automatic transmission components that have a long history of reliability. The main draw back with this unit is its ratio selection. It has as the lowest ratio 2.17 to 1. This ratio could be managed but it would require a very slow turning, large diameter multi blade prop. This is not all bad because it would have the prop operating in a very efficient range. Another draw back for an E-Racer application is that it is a totally concentric unit, ie. no center to center distance. It is a very light weight unit at about 18 lbs. but at \$2000.00 its a little out of range of my curiosity budget. He has another unit based upon the same technology but with an interesting twist. It uses the ring gear from the planetary set but omits the planets. It runs the sun gear (pinion), which has external teeth, directly engaged with the ring gear which has internal teeth. This results in a large number of teeth engaged at any given time. This feature has several advantages. It would certainly reduce the vibration levels below those of the marine unit used now. It also would distribute the torque loads more efficiently reducing the stress levels on each tooth and shear stresses in the oil. Lou is building this unit with a 1.85 to 1 reduction drive ratio which fits nicely with E-Racer requirements. It also has a 1.4 inch center to center offset which is less than the current unit but manageable. Unfortunately for me it does not reverse the prop rotation which means a different prop. It has one major draw back and that is that the gears must be cantilevered off the end of their respective shafts. This can be handled if it is properly designed with adequate shaft and bearing sizes. It too costs about \$2000.00 and so my decision as to what unit to go back in the air with is still undecided at this time. A decision needs to be made soon since I must order my prop now if I expect to get back in the air anytime soon. all this discussion just serves to demonstrate the many trade offs required when designing a new aircraft, such as the E-Racer, that uses untried or undesigned hardware.

E-Racer "T" shirts are still available from SDS. They come in two sizes, large and extra large. The large size is powder blue and the extra large size is royal blue. Both come with a beautiful E-Racer on the back which is an air brushed modification of the "Vantage cigarette" airplane. On the front it says: "I'm Sticking to My V-8 E-Racer". Sorry, I don't have anything for the Mark II enthusiasts. Price is \$9.00 ea. including shipping.



JUNE 21. 1989

E-RACER NEWSLETTER NO. 12
SECOND QUARTER, 1989

Published quarterly by:

SIERRA DELTA SYSTEMS
1702 W. Mc NAIR
CHANDLER, AZ 85224
(602) 491-1548

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Sierra Delta Activities;

The reconstruction of the E-Racer prototype is well

advanced. All external belly damage has been repaired and painted. I now have the fuselage turned right side up and I have repaired all internal fiberglass damage on the inside. I am now in the process of custom fitting the new gear legs into the aircraft. Once the gear legs are back in the airframe and all linkage re-installed and functioning, I will turn the A/C back over to complete the gear leg flanges which blend the legs into the lower strakes and fuselage. This will involve fabricating new gear doors that are glassed as permanent attachments to the gear legs as well as the lower wheel covers that seal up the wheel well when the gear is retracted. Once all that is done I will paint the legs and do some final paint touch up on the fuselage and the main gear will be finished.

Next, I will move to the front of the A/C to complete the nose gear modifications. This will involve the modifications that are necessary because I have installed a new nose gear strut that is two inches longer than the original one. I am doing this in order to gain a two degree increase in static angle of attack. This will reduce the rotation speed of the A/C when it is loaded to forward center of gravity (two people in the front). Previous experience with the prototype showed that this would be necessary. I have removed the nose wheel cover and opened the nose wheel cavity aft the necessary two inches. This was uncomplicated because the instrument panel is aft of the nose wheel cover on the E-Racer allowing the cover to be moved without interfering with any structure or systems. I now must glass the nose wheel cover into its new position and rework the nose wheel opening to match. Once this is complete I will convert the nose gear over to a hydraulic system tied into the main gear actuation system. This will result in an all hydraulic system rather than the dual system that I had before. It originally had an electrically actuated nose gear. This new system will simplify the gear extend and retract procedure. A welcome change. Except for some minor paint repair and one small tear on the under side of the left wing this will complete the repair of the aircraft.

Final reassembly will include the installation of the engine and reduction drive along with all the supporting systems including radiators, revised fuel system, oil coolers and a new prop. I have ordered and received a very expensive magneto (a Vertex mag with remote mounted coil and mechanical tach drive) to replace the battery powered system that I had before. The mag will provide a reliable and independent ignition system that will not be vulnerable to numerous failure modes as the previous system was. I will fly with this single ignition system at least for the initial flights. I plan to add a second back up system in the form of a crank triggered multi coil discharge ignition system that will fire a second set of plugs in the heads. This should provide enough redundancy to keep a fire going in the cylinders for a long time. I don't ever want to experience another ignition failure in the air again.

I am still trying to resolve the landing gear supply problems for those of you who have been patiently waiting for your orders to be filled. The problem centers around the load testing that has been conducted to date. It has shown that the gear needs some additional material at the top at the knee joint. I made a material change from carbon fiber to "S" glass for the gear because the cost was very high to make them out of carbon fiber and also because the means of producing the gear out of "S" glass was less labor intensive than with carbon further reducing the cost to produce them. The problem is that the "S" glass has a lower modulus of elasticity which results in more gear deflection than I want in the product. My structural requirement for the gear is no permanent damage to the gear up to 2 "G" and no failure to support the A/C up to 3 "G"s. I am in the process of building another test leg with an improved glass layup that will be tested in the next few weeks. Once I am satisfied with the new design I will authorize my supplier to begin limited production of the product which will fill my current orders. I have discussed the problem with some of the builders who have sent deposits on the gear. Some of them are willing to pay the extra to have the gear made from carbon fiber. This results in an exceptional gear in terms of strength, but it comes with a higher price tag. If I haven't talked with you and you want to know more about this option let me know.

As far as returning to Oshkosh with the E-Racer this year, it will not be possible. I just have too much to do and I also need a significant amount of flight testing to rebuild my confidence in the modifications and repairs. Sorry guys.... maybe next year.

E-Racer "T" shirts are still available from SDS. They come in two sizes, large and extra large. The large size is powder blue and the extra large size is royal blue. Both come with a beautiful E-Racer on the back which is an air brushed modification of the "Vantage cigarette" airplane. On the front it says: "I'm Sticking to My V-8 E-Racer". Sorry, I don't have anything for the Mark II enthusiasts. Price is \$9.00 ea. including shipping.

The following is a list of authorized E-Racer suppliers.

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| Foam, fiberglass and resin; | Alpha Plastics 8734 Daffodil Houston, TX 77063 (713) 780-0023 |
| Mark II motor mounts Ball bearing controls | Weldtech, Inc Route 2, Box 2704 Benton City, WA 99320 (509) 967-5660 |

IV

E-RACER NEWSLETTER NO. 13
FIRST QUARTER, 1990

FEBRUARY 2, 1990

Published quarterly by:

SIERRA DELTA SYSTEMS
1702 W. Mc NAIR
CHANDLER, AZ 85224
(602) 491-1548

It is mandatory that all E-Racer builders subscribe to this newsletter, as this is the only formal system I have to communicate information and updates to the builders.

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When writing to SDS with questions, please send along a stamped, self addressed envelope if you wish a personal reply. If you call, you can reach me in the evening between 7:00 pm and 9:00 pm at the above listed number. Please respect this call in time block.

The following prices are currently in effect as of the date of this newsletter:

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|--------------------------------------|--------|
| Information kit..... | 9.00 |
| Newsletter..... | 12.00 |
| Plans, Airframe..... | 250.00 |
| Auto engine installation details.... | 150.00 |

I am now releasing plans on a limited basis to those builders who wish to build an E-Racer Mark II. (Aircraft engine version) This means that I am mailing out the first chapters to plans purchasers upon receipt of the fee. Subsequent chapters are being sent out as they are completed. These plans are preliminary releases and are not the final version. I am doing this in order to make it possible for anxious builders to get started on their projects sooner than would be possible if they had to wait for the final plans package. The E-Racer Mark I (auto engine version) is still in the development phase and I will not release auto installation details until I am totally satisfied with its performance.

Sierra Delta Activities;

NEWSFLASH --- E-RACER PROTOTYPE RETURNS TO FLIGHT STATUS

4. The torque tube and cable primary flight controls used in the ailerons and rudders were not effected by the flames and high temperatures. Boat cables or hydraulic lines for aileron controls would not have faired as well in this accident. The aircraft remained 'flyable' even with substantial fire damage.

5. The solid foam core in the fuselage acted as a significant flame barrier preventing a burn through to the strake tanks during this accident. a solid fiberglass skin would have softened, burned, and exploded the fuel tanks.

The E-Racer was trucked back to Phoenix where it is slowly being rebuilt. I have repaired all the fire damage in the engine bay. I have built new carbon fiber landing gear legs and one is now installed into the airframe. I need to finish the landing gear installation and then I will flip the A/C over and repair the external fire damage to the fuselage and wings followed by filling and finishing of the affected areas. Also, from my list of lessons learned I plan to incorporate all the improvements suggested to make the E-Racer the safest homebuilt in the sky.

In summary I would like to state that this accident was the result of the unseen hazards of an unshielded exhaust system. I do not feel that it casts any doubt as to the safety or reliability of the E-Racer airframe, the composite construction methods used or the auto engine installation. I feel that it has in fact shown the design to be very safe indeed as I am alive today as a result of this inherently safe and sound aircraft.

E-RACER PLANS STATUS:

The plans are now 98% complete as a result of the fine efforts of Bill and Dianne Warner of West Worthington Ohio. I am in the process of sending out update packages to all current plans holders. Some have already received this package. If you haven't received yours, it will reach you within the next month. Subsequent releases of plans will also be mailed out as they become available.

Because of professional ethics I cannot provide a complete set of construction plans for the Roncz canard. I can only provide the differences between the Long EZ (Roncz) canard and the E-Racer canard. This is because the Roncz canard plans are still offered for sale by RAF. this will require that each of the plans holders purchase a set of Roncz canard plans from the Rutan Aircraft Factory, Mojave, Ca, phone (805) 824-4976. These will run about \$35.00. Sorry I have to do it this way.

Several items have been made available for sale by some E-Racer builders to assist other builders. A photo package of over 100 photos taken of Earl Haguewood's and Wes Gardner's E-Racer projects is available from SDS which has been provided by plans holder Scott Berry, write or call for cost and availability. Also available is a 45 min. VHS video tape of the E-Racer prototype in flight and a technical interview with yours truly talking about its major features including close up detail shots. This tape is also available from SDS for \$20.

At long last, I have some good news to report in this newsletter. On December 26, 1989 I conducted the re-flight of the E-Racer prototype. The flight lasted about 30 minutes with only one minor problem. When the landing gear was deployed, one main gear indicator light did not illuminate. I made several passes down the runway while talking to my ground crew in order to confirm that the gear leg was actually down. A normal landing was then executed completing the milestone flight. This flight was conducted without a working tachometer. The electric tach on the panel was suspected of causing the ignition loss at Dubuque, Iowa that resulted in the crash landing and so I was unwilling to fly with it connected again. Therefore, I was unable to get any meaningful performance data on this flight. After some investigation into the failed gear light, I flew another flight to get some air to air video of the plane. Gary Hertzler provided the photo plane (Varieze) with E-Racer plans holder Scott Beery doing the camera work. We shot about a half hour of video, but a lack of available room in the Varieze made it difficult to get any good tape. I took the opportunity to re-familiarize myself with the aircraft. The most significant thing I noticed was higher than normal vibration levels which I made a mental note to investigate. Once back on the ground I discovered that I had a prop tracking error of about 1/2 inch at the tips. I shimmed and torqued the prop to eliminate this problem and flew another test flight later in the afternoon. The vib problem was greatly diminished and I was able to begin to enjoy the fun of flying the E-Racer again. I finished the day off with a series of aileron rolls and steep bank turns and climbs.... A great way to end a great day.

Subsequent flights were made in the following days with many changes and refinements tested. The most significant of these were a change to a different Holley carb in conjunction with a mechanical mixture adjusting device that provided altitude leaning capability while in flight. I also remounted the Z-drive gear box on thick rubber pads and added automotive style rubber engine mounts to the engine in an effort to eliminate the last bit of airframe vibration.

On New Years day I flew the E-Racer over and back to an IVCHC breakfast flyin at Chino, CA. The aircraft was a great hit at this event and as usual, I had to remove the cowlings to show the engine installation. I made a low pass down the runway after my departure take off to everyone on the ground's delight. The aircraft performed flawlessly both ways and demonstrated that my confidence in it so soon after the re-flight was well founded. By the time of this flight I had installed a mechanical tach which gave me the means to evaluate A/C performance. Using this, I determined that my new prop has more effective pitch than the old one and it limits max. engine RPM to about 4400 vs the previous 4800 RPM. Several speed runs were made resulting in a solid 225 MPH TAS at 6500 feet which is the same or slightly

Builders Report

Four west coast builders are in the final stages of construction. It is not known which one will be the first to fly. The race is between Wes Gardner, O-360 MK11, Earl Haguewood, O-320 MK11, Jim Hays, Ross/Mazda MK1, Dick Smith, Ross/Mazda MK1 and Bob Moore, O-320 MK11. By years end we should know who the winner will be. There are also some Florida builders who may sneak into the lead. Time will tell.

E-Racer "T" shirts are still available from SDS. They come in two sizes, large and extra large. The large size is powder blue and the extra large size is royal blue. Both come with a beautiful E-Racer on the back which is an air brushed modification of the "Vantage cigarette" airplane. On the front it says: "I'm Sticking to My V-8 E-Racer". Sorry, I don't have anything for the Mark II enthusiasts. Price is \$9.00 ea. including shipping.

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| Mark 11 motor mounts Ball bearing controls | Weldtech, Inc Route 2, Box 2704 Benton City, WA 99320 (509) 967-5660 |
| E-Racer Canopy | The Airplane Factory P.O. Box 24035 Dayton, OH 45424 (513) 849-6533 |
| Nose gear strut Nose wheel cover (NB) Nose strut cover (SC) | Featherlite Products P.O. Box 781 Boonville, CA 95415 (707) 895-2718 |
| E-Racer Landing gear legs | Sierra Delta Systems 1702 W. Mc Nair Chandler, AZ 85224 (602) 491-1548 |
| Wings (prefab) | Composite Consulting 3021 Airport Ave. Santa Monica, Ca 90405 (213) 397-4110 |
| Canard (prefab) | Tom McNeilly Gilbert, AZ (602) 899-7613 |
| Wheels and Brakes | Matco (Formerly Rosenhan) Salt Lake City, Utah |
| Shirl Dickey | |

higher than before. This means that my new prop is more efficient than the old one. On this flight I cruised at a rather low engine speed of 3700 RPM while achieving ground speeds of over 200 MPH both ways. Fuel burn was a high 10 GPH since at that time I did not have my mixture control device on the engine. Oil ran at a cool 190 deg. and 60 psi.. Coolant held a steady 140 deg. and 15 PSI. Very satisfying performance.

The E-Racer was down for several weeks while I worked on the installation of a transponder and blind encoder. This was necessary in order to comply with the new mode C requirement that came with the change of Phoenix International Airport from an ARSA to a TCA. This installation is now complete and functional and I am now legal to continue the E-Racer flight development program.

My immediate plans call for the installation of a new more efficient and lower drag exhaust system. I have high hopes that this will result in significant improvements in max. speeds for the A/C. I also need to do some paint and trim color improvements in order to make it presentable at this years fly in circuit. If air speeds show promising results I would like to enter the Sun 60 race at Sun and Fun this year as well as the R.A.C.E. cross country races and kilo trials events held for Rutan type aircraft this season. Other small improvements will include new softer seats, replacement of the cracked canopy and the addition of outer gear closure doors. The aircraft is very close to its final configuration now and I am anxious to complete the development and testing phase and get on with flying for the fun of it.

Plans Status:

I now have help with the completion of the E-Racer plans package. E-Racer plans holders Bill and Dianne Warner from West Worthington, Ohio are doing the conversion of my hand written manuscripts and sketches into computerized text and drawings. They are doing a fantastic job and I will be sending the results of their efforts to plans holders in the near future. Almost all of the plans chapters are in the final stages of this conversion. Only the Canard chapter and a final version of the wing chapter along with some small detail items remain to be submitted. Once the plans package is completed I plan to begin an advertising program in conjunction with showing the prototype at this years flyins to promote this fine design to the general public.

E-RACER NEWSLETTER NO. 14

Published quarterly by;

SIERRA DELTA SYSTEMS
1702 W. McNAIR ST
CHANDLER, AZ 85224
(602) 491-1548

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| Airframe Plans, MK-I & MK-II..... | \$250.00 |
| Auto engine installation details..... | N/A |

I am now releasing plans on a limited basis to those builders who wish to build the E-Racer Mark-I and Mark-II airframe. I am also supporting Mark-I builders with technical support on the Buick V-8 version only. If you wish to discuss other engine options please contact me for my specific recommendations.

SIERRA DELTA ACTIVITIES

Much has happened with the E-Racer since the last newsletter was released. I attended the Antique Fly In at Casa Grande, Az. in March of 1990 where the aircraft was well received. I spent the day surrounded by interested spectators who kept me busy answering an endless list of questions. This was its first public showing since its return to flight status after the Dubuque, Iowa loss of power incident in 1988. The aircraft configuration at this flyin was basicly the same as before except that I had replaced the battery powered ignition with a Vertex magneto.

Subsequent to this flyin I made two major improvements to the A/C. I replaced the lower shaft and gear in my reduction box with a single piece gear shaft. This eliminated one spline joint and the small amount of backlash associated with it. The backlash resulted from some impact pounding that was evident at this interface. This modification improved the strength and reliability of the unit. The second and most significant change was the installation of a redesigned exhaust system. It consisted

of a 4 into 2 header for each side of the engine. The two exhaust pipes on each side were positioned to dump into an augmentor outlet duct replacing the four short stacks previously used. The new system aims the exhaust aft and keeps it attached to the fuselage and directs it into the hub of the prop. This system had two immediate benefits. Drive train vibration was reduced to next to nothing. All this time I had been chasing drive train components and engine mounts to eliminate vibration when the majority of it was caused by the exhaust disturbance through the prop from the old system. The engine and drive system are now near turbine smooth. This discovery has renewed my faith in the viability of the marine converted gear box that I have so often questioned in the past. I can now put that concern to rest and unequivocally recommend the use of this unit for all future MK-I aircraft. The second benefit of the new exhaust system was a substantial increase in aircraft performance. Airspeed went up by 15 MPH at the same engine RPM. This was not due to an increase in horsepower but rather to reduced airframe drag and increased prop efficiency. The aircraft is finally starting to demonstrate its true potential.

My next event was an R.A.C.E. sponsored cross country air race at Kanab, Utah on Memorial Day 1990. I took a 1st place finish in the Unlimited Class with an average speed of 220 MPH over the 96 mile course. This event takes place at about 6000 ft MSL with two turns. I missed taking first place over all due to an over confident (wide) 1st turn where John Chamber's very fast Super Modified Varieze nipped me for the lead. John's Varieze is currently the fastest Rutan type on the planet and he lead me across the finish line by less than 100 ft. What I didn't know at the time was that I was losing speed and RPM as a result of wear of the points rubbing block which was slowly closing down my point gap. I learned later that the Vertex factory had installed a high RPM points spring that caused this wear to occur. The next day when I was leaving Kanab, the engine would not even start. I don't know how it continued to run during the race. It took me about an hour to zero in on the cause of the problem. I have since replaced the points with a long life points set that should eliminate this problem in the future.

After the Kanab race I installed a neat little mechanical leaning device on my Holley carburetor that allowed me to adjust the fuel/air mixture over a wide range from the instrument panel while in flight. I then flew to Albuquerque, NM for the Duke City 100 air race. There was some tough competition there with four SX-300's entered. I had no chance against these high priced homebuilts but I felt that everything else was within my sights. I had a very fast race going for most of the 100 miles but about 15 miles from the finish I had to pull up lame with a burned spark plug and two warped intake valves. I limped in to the finish with a disappointing average speed of 198 MPH. This was far below its potential but still ahead of every thing else except the four SX-300's. The reason for the lean out damage to the engine was the lack of an EGT to tell me where to set the mixture and my unfamiliarity with my new leaning device. The last leg of the race included a descent from 8500 ft. to about 6000 ft and during this decent I failed to richen up the mixture which would have prevented the damage. Needless to say an EGT probe would be the next investment I would make. I replaced the burned spark plug (95 cents at Checker Auto) and gave the engine a compression check

at the race site. Two cylinders were down to 40 psi compression vs a normal 160 psi. This confirmed that the pistons were intact and two intake valves were warped. The engine ran fine upon start up and so with friends Mike and Jan Marker (Long EZ) as an escort I flew the E-Racer back to Phoenix at reduced power. Once again the little Buick had proven to be very tolerant and forgiving allowing me to make this return flight without incident. Once back home I made the valve repairs in short order and was ready for my next event which was Jackpot, NV on the 2nd of July 1990.

Prior to the Jackpot event I went over the aircraft making minor modifications to reduce drag and increase my speed. I didn't want to get beat by John Chambers again. I closed down some gaps around my gear leg openings, added an EGT probe, a manifold pressure gauge, and revised my oil cooling system to reduce cooling drag. I also added some canopy latches at the mid point in order to prevent the canopy from lifting off its seals at high speed. All these mods had an unexpected result. In addition to increasing the speed of the A/C it also reduced the circulation airflow around the engine compartment. This would have a disastrous effect in the race. On my flight to Jackpot I cruised at 10,500 ft at an impressive true airspeed of 220 MPH. Engine speed was 4000 RPM and about 16 in. of manifold pressure. This performance was the best cruise I had ever seen to date. I had the distinction of having Jeana Yeager (Ms. Voyager) as my co-pilot during the race. Things looked good at the start with the E-Racer jumping out to an impressive lead over the other competition. however it didn't take long to determine that under the racing conditions of 4700 RPM and 24 in. of manifold pressure my oil temperature headed for the twilight zone. At 280° f I throttled back to 4400 RPM and 22 in. of manifold pressure where I tried to get the oil temp to come back down. We cruised at this speed for about 50 miles when the rest of the competition finally crept up on us just before the first turn. Since oil temp had dropped to 260° I throttled up to full power. Again I pulled away from the competition and again the oil temp began to rise. I held this power around the first and second turns and when oil temp again reached 280° I throttled back. I held this setting until about ten miles out from the finish line and the competition had again caught up with us. I decided that it was time to quit messing around and win the race and so again I throttled up to full power. We ran about 5 miles under this condition when I had a sudden drop in power followed by smoke in the cockpit. From here on things got real serious as I didn't have enough energy to reach the airport. Engine speed dropped off to 3000 RPM and I was trying to hold altitude. When the smoke got unbearable I opened the canopy in flight. The canopy jumped open about six inches and allowed a free flow of fresh air to clear away the smoke and about this time I felt like I had enough energy to make the runway. I lost all engine power at this time and was committed to a dead stick landing. Sometime during the emergency I called the ground advising them of the fire on board and requested fire extinguishers to the runway immediately. I made a surprisingly smooth landing with huge flames pouring out of the engine bay and gear leg openings. We rolled out straight until I lost rudder effectiveness and the since my brake lines had been burned I lost directional control (about 40 MPH) and the A/C drifted slowly off the right side of the runway. Jeana jumped out at about 10 MPH and I followed her shortly after just as the landing gear was collapsing. The

A/C ended up about 20 ft off the right side of the runway. The guys with the fire extinguishers came running up with Halon bottles and had the fire out in a matter of seconds. Both Jeana and I were unhurt in the accident and the E-Racer was substantially damaged but not totaled. The guys with the fire extinguishers were on the spot so fast that the damage was contained to just the engine and landing gear.

What can be learned from this incident that can be used to increase the safety of all aircraft and especially auto powered aircraft. In this case the fire was caused by the glowing red unshielded exhaust pipes that were too close to the surrounding fiberglass structure. This caused the fiberglass/resin of the inside fuselage and cowlings to ignite after sustained exposure to the high radiant temperatures. It was very fortunate that no fuel was involved in the fire. This kept the fire to a much less aggressive level, in fact once the forced air of forward motion was removed when the A/C came to rest the fire almost died out on its own. The reduced airflow in the engine bay that resulted from my speed modifications increased the temperatures of nearby components and then without adequate shielding they reached ignition temperature under the racing conditions I was exerting on the aircraft.

lessons learned:

1. Shield all fuel system components and lines with fire sleeving.
2. All exposed engine bay surfaces must be insulated with firewall shielding and insulation.
3. All exhaust pipes and headers must be shielded and air cooled to avoid concentrated hot spots in the engine bay.
4. Adequate airflow must be directed over the engine even at the expense of some added cooling drag.
5. An on board Halon fire extinguisher system directed at the engine and controlled from the cockpit is highly recommended.
6. Fireproof brake fluid is also highly recommended since I feel that in the last stages of my flight and landing the fire was aggravated by pumping flammable brake fluid onto the fire by my repeated attempts to use the brakes to control the roll out.
7. Never use any plastic components in the fuel system such as fuel filters or plastic fuel lines.

Some fortunate features of the E-Racer;

1. The forward tilting canopy was very beneficial allowing its safe opening in flight without upsetting the flight characteristics of the aircraft. This resulted in the rapid clearing of very toxic fumes from the cockpit and allowed the aircraft to be flown safely without additional distractions.

2. The inherent safety of a canard aircraft allowed a safe unpowered approach to a landing without the risk of a stall/spin accident at minimum flying speed.

3. The mid/rear engine design resulted in the fire being forced aft, away from passengers and crew eliminating direct exposure to the flames.

SIERRA DELTA SYSTEMS

Home of the 'E-RACER'

1702 West McNair Street
Chandler, Arizona 85224
(602) 491-1548

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| Auto engine installation details..... | N/A |
| E-Racer Video (refundable w/plans purchase) ... | \$20.00 |

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E-RACER PROTOTYPE ACTIVITIES

Repairs to the E-Racer prototype have resumed after a six month hiatus. I have completed the installation of the new landing gear legs and the hydraulic retract actuators and linkage. I am now working on the installation of the wheels, brakes and axels. Once this is complete, I will flip the aircraft over and do the cosmetic repairs to the exterior fuselage and wings. I will also complete the landing gear leg lip seals and gear doors. Once this is all complete all that remains is to repair the fire wall, replace some burned wiring and then reinstall the engine and drive train. I have a target completion date of re-flying the aircraft before Thanksgiving. Actually I should be able to have it in the air by the first of the year, but as things go, it always seems to take longer than I anticipate.

Congratulations to Dave Ronneberg on the successful first flight of his new design the 'Bercut'. It is the second aircraft to fly with the E-Racer landing gear. (The first was the E-Racer prototype) The Bercut is a stretched Long EZ with tandem seating, an 0-360 Lycoming engine and of course, fully retractable landing gear. Reports are that it is very fast. I look forward to meeting him in the R.A.C.E. Unlimited EZ class air races next year. By then I expect that other E-Racers will also be flying and looking towards the same challenge. Wes Gardner, with his 0-360 Lycoming powered E-Racer should also give Dave a run for his money. Dave chose to use an electrohydraulic actuation system for his landing gear installation. I do not fully support this approach due to its high cost, high complexity and higher weight, however it looks like Dave has made it work successfully. He showed the aircraft at Oshkosh this year. Look for more on this aircraft in the homebuilt press.

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Several E-Racer builders are close to first flight. Earl Haguewood seems to be in the lead at this time with his 0-320 Lycoming powered E-Racer. Close behind are Wes Gardner (0-360 Lycoming), Jim Hays (0-320 Lycoming), and Dick Smith (Ross/Mazda). Earl Haguewood's empty C.G. came out at 107.5 This is a little far forward which is good. He plans to relocate his battery to bring his CG back to between 109 & 110.