(Photo Courtesy JRS Enterprises)
Artist's rendition of the Sandberg/Boland "Tsunami", an original design unlimited racer now nearing completion in California.

Tsunami

By Jack Cox

(Photos by the Author)

WHEN TEX JOHNSON flashed across the finish line to win the 1946 Thompson Trophy race in Cobra II, the era of the homebuilt unlimited air racer came to a sudden and resounding end. Surplus World War II fighter planes, stripped of their military hardware and with their powerful Merlins, Allisons and Pratt & Whitneys boosted to the breaking point, were simply too much for the little shoestring operations that ruled the roost in the 30s with their backyard creations. Over the succeeding years at Cleveland and more recently at Reno, the highly modified Airacobras, Corsairs, Bearcats and Mustangs swept the postwar unlimited races . . . and the Mystery Ships, Laird Solutions, Gee Bees, Wedell-Williams, Folkerts, Mr. Mulligans and Laird Turners slowly faded into legend.

Oh, there were dreamers, of course . . . those fellows who loved to lounge around the airport cafes, bars and shops regaling all who would listen with their dreams of jacking up a Merlin and building the lightest, smallest airframe behind it that a pilot could sit in . . . then, boy, would those Mustang drivers be in for some rude shocks!

But all of them weren't simply dreamers. Some highly competent aeronautical engineers took the time to crunch enough numbers to come to the conclusion that, indeed, the modified fighters **could** be beaten. There was, they discovered, a narrow band between the onset of compressibility and the speeds the most powerful reciprocating engine could generate in a large warbird airframe . . .... a little slice of the subsonic performance spectrum a sufficiently clever aerodynamicist supplied with sufficient money might squeeze into.

They had discovered a new mountain . . . and as we all know, mountains are there to be climbed.

As you are reading this, several teams are working furiously to complete "homebuilt" racers in time for this year's Reno Air Races . . . and if they are successful, another era will have ended. The war surplus air racer will be dead and gone . . . forever.

In February, *SPORT AVIATION* had the opportunity to visit one of the teams and interview the designer of its new racer.

In the mid-60s a team of uniquely talented men came together to create the modified Bearcat that Darryl Greenamyer would use to thoroughly dominate unlimited class air racing from 1965 to 1971 . . . and set a new world speed record for propeller driven airplanes in 1969. It consisted of Bruce Boland, a Lockheed aeronautical engineer who specializes in conceptual design, aerodynamics and structures; Pete Law, another Lockheed engineer and the team's answer man when the time comes to figure out how to cool an engine operating far in excess of what was ever intended; Ray Poe, now retired from Lockheed and a wizard when it comes to systems — electric, hydraulic or whatever; and Phil Greenberg, the master of metals who takes all the ideas, plans and schemes and translates them into beautifully crafted structures a pilot can take out to do battle with the physical laws of the universe.

The team would later be similarly involved with the development of Greenamyer's F-104, Miss Candace/Jeannie, the Red

Bruce and Dorelle Boland.

PROFILE . . . BRUCE BOLAND

By Jack Cox

As the Project or Consulting Engineer on racers that have taken 17 first place trophies and set two world speed records, Bruce Boland has earned a special niche in the annals of air racing history. Having been actively involved in unlimited air racing for the past 19 years means his participation stretches over a period longer than the total existence of the old National Air Races at Cleveland and Los Angeles, including the post-war events. You have to hear the litany of his credits to really comprehend his contributions to the sport, however. Try these on for size:

● Darryl Greenamyer's Bearcat — redesign and construction of a new vertical tail, design of wing fillets, new exhaust stacks and fairings, propeller/engine performance, weight and balance, gear door vents, flight test program.

Results: World speed record (483 mph) in August 1969. First place at Reno from 1965 through 1969 . . . and again in 1971. Airplane now in the National Air and Space Museum.

● Red Baron RB-51 — Project engineer, in charge of all engine/propeller performance, stability and structural analysis. Redesign of engine mount, vertical tail; design of new canopy, windshield, fuselage bathtub fittings, supercharger gears, new cowling, exhaust stacks, carb duct and elbow, ventral fin, wing fillets, fuselage beef-up, prop optimization, weight and balance and flight test program.

Results: Set current world's speed record for recip prop-driven aircraft (499 mph) in 1979. First place at Reno in '77, '78, Miami in 1979, Mojave in 1974, '76, '78 and 1979.

● Miss Candace (1970-1977)/Jeannie (1978-1981) — Project engineer. Prop/engine performance; designed new canopy, radiator ducts and air scoop, wing fillets. Weight and balance and flight test program.

Results: First place at Reno in 1980, '81. Mojave in 1975. Of special significance is the fact that Miss Candace/Jeannie, as modified by Bruce and his team, has become the "prototype" for a number of clones, including last year's Reno winner, Dago Red, and a duplicate presently under construction.

Over the years, even while serving as Project Engineer on the aforementioned racers, Bruce somehow found time to do consulting work on a whole host of other aircraft, including:

- Darryl Greenamyer's F-104 (world's speed record)
- Chuck Hall's P-51D "Miss RJ"
- Howie Keefe's P-51D "Miss America"
- John Sandberg's P-63 "Tipsy Miss"
- Larry Havens' P-63
- Dick Weaver's P-51D
- Frank Sanders' Sea Fury
- Sherman Cooper/Mike Carroll Sea Fury
- Mike Carroll's Cobra II
- Planes of Fame's F4U-1 "Budweiser Light" powered with a P&W R-4360.

— And quite a number of other non-racer warbirds . .

Baron and last year's Reno winner, Dago Red — just to list a few of their more successful efforts.

In the early 70s, Bruce and industrialist/air racer John Sandberg began talking about a homebuilt unlimited, kicking around every conceivable configuration, engine, type of construction, etc. — and the amount of power required to be competitive. Bruce ran some numbers and determined that given the Reno lap times of the early 70s, they would be able to show their tailfeathers to existing racers with only 1500 or so horsepower. This, of course, in the very small, lightweight airframe they had in mind.

Throughout the 70s, however, Reno speeds kept climbing, so that every time Bruce and John got together — usually during the September races — they had to revise their power requirement upward. Among his various enterprises, Sandberg owns an aircraft engine overhaul shop, JRS Enterprises, and being a Kingcobra owner, is partial to Allisons. Initially, this was their engine choice, but when the power requirement crept up over 2000 horsepower, they switched to the Rolls Royce Merlin.

Finally, in 1979 during the trials in which the Red Baron set the current world's (prop) speed record of 499 mph, John gave Bruce the go-ahead. Design and build the airframe he said, and I'll build and test the Merlin. As project engineer and manager, Bruce's first move was to get on the phone and pull together his team of Law, Poe and Greenberg.

The next item of business was to name the airplane. The team particularly savors names and has a lot of fun dreaming up hard to pronounce monikers that often have several possible connotations. One evening, Bruce, his wife, Dorelle, and Phil were in a bar bouncing all sorts of names off each other . . . but none seemed to fit their slightly weird criteria. Finally, Dorelle recalled something she had heard Dr. George use the night before. Dr. George is a LA TV personality, a far out weatherman with a penchant for disasters of all types: floods, hurricanes, shipwrecks — anything high on the stupendous scale. His most recent show had been on tidal waves and he had made a big deal out of the Japanese term for the phenomenon — which is tsunami.

"Tsunami" — that was it! It represented an awesome force in nature, would be pronounced a hundred different ways — all but one hilariously incorrect — and certainly was different from the usual "Miss this or that", "Spirit of whatever", etc., that Bruce, particularly, hates. Already they have been rolling in the aisles at hearing it pronounced "salami", "toots-u-name-eye" and worse.

(I hate to spoil their fun, but the correct pronounciation is "SUE-NOM-EE".)

Anyway, with financial backing and a tricky name, it was time to get to work. Bruce is the one who conceives airframe configurations and designs structures, so it all had to begin at his drawing board. He freely admits that he draws heavily from the work that has been done in the past (he's an avid history buff), so his starting point was a thorough review of the old Supermarine and Macchi world record holders (you'll learn the significance of this shortly) and, of course, the Messerschmitt 109R which held the world's prop speed record (469.22 mph) from 1939 to 1969. His greatest inspiration, however, came from the Heston/Napier Type 5 racer of 1940.

What evolved over a period of time was the aircraft you see depicted in the drawings accompanying this article. It begins up front with a stock Mustang spinner and progresses back to a fuselage that tries its best to hide behind the spinner. The prop will be a four bladed Aeroproducts model from a T-28A. It is very similar to the P-51H prop, but with a smaller diameter. This is particularly important as it fits into what Bruce wanted for prop clearance and, of course, keeps the tips away from compressibility. He expects Tsunami's prop to be running at a lower tip speed than any other unlimited at Reno . . . which means he expects his prop to be the most efficient one there.

The engine is somewhat of a surprise. Right from the beginning, Bruce and John intended Tsunami to not only be a winner at Reno, but also to take the world's speed record from the late departed Red Baron. You'd think, then, they would want to stuff in the biggest, hairiest engine they could find. Remember, though, that the Tsunami concept is to go fast by means of aerodynamic finesse rather than sheer brute force. The idea is to keep the airframe as small and light as possible and use just the calculated power required to achieve a goal of about 520 mph, straight and level . . . and no more. More power would simply mean a heavier engine, the need for more fuel and coolant, which means more weight, etc., etc. — all of which would lead right back to something no better than a modified Mustang.

Consequently, the engine chosen was a Merlin with a single stage blower — weighing 1500 pounds as compared to the 1850 pounds of a double stage -7 or -9 model. It was built up in John's shop last year and raced at Reno last September in a stock Mustang. It has the power needed and will be virtually a bolt-in item when the Tsunami airframe is completed. A proven P-51 mount was used, shortened in the rear between the engine and firewall. Viewed head on, Tsunami's engine nacelle is reduced from the dimensions of a Mustang by 8 inches on the top side, one inch on each side and 12" on the bottom side . . . and the remainder of the fuselage flows aft from this absolute minimum flat plate profile.

The fuselage is being built in 3 sections, the engine nacelle, and immediately behind it, what Bruce refers to as the "liquid bay". It will house 3 tanks: 50 gallons of fuel, 45 gallons of water for the spray bars that help cool down the radiators and another 45 gallons of ADI ("anti detonation injection"). ADI is what is usually referred to as water injection, except that the racers commonly use a 50/50 mixture of water and methanol. Another 50 gallons of fuel will be carried on each side of the wing center section, and there will be provision for an additional 20 gallons in each outer wing panel, although this will not be used in closed course racing.

All of the liquids are grouped around the CG to minimize trim change during the course of a race.

Bolted on to the bottom of this "liquid bay" will be the 27.5' wing. It has an area of 146 square feet, compared to a Mustang's 237 sq. ft. Due to Tsunami's gross weight of only 5100 pounds, however, the wing loading will be a pound or so less than that of a P-51. The airfoil is Bruce's own creation — a very specialized modification of a NACA 63212. He wanted a wing with flight characteristics similar to those of one utilizing a symmetrical airfoil . . . but needed the extra internal volume of something like the 63212 for retracting the gear. On the other hand, he didn't like the pitching moment of the 63212 . . . so he tried to retain the desirable features of each by altering the mean camber line of the 63212 and working on its leading edge to get a better stall characteristic. Only flight testing will reveal how successful he was, but the approach was conservative enough that it should work well.

The main gear legs are from a Piper Aerostar, fitted with Lear Jet wheels and brakes — feasible since Tsunami and the Aerostar have similar gross weights. The Lear Jet's 18 inch tire diameter fits nicely into the space available in Tsunami's wing.

The third section of the fuselage places the pilot further aft than anything seen since the racers of the 30s. He'll fit under a tiny canopy (to be made by Jim Cowley of Mojave, CA), which will swing up and back for entry and exit. High pressure jet orifices will be mounted so as to spray solvent on the canopy in

. wet wing analyses, stability and control, tip tank installations, etc.

Tsunami actually isn't Bruce's first effort to design and build a "homebuilt" unlimited racer. He made a proposal to Smirnoff in 1966 for one design and he and Ray Poe were actually cutting metal on one of their own in the early 70s. It was shelved for lack of funds, but the sale of its Allison engines to John Sandberg was the start of the relationship that ultimately resulted in the Tsunami project. Bruce has also designed a Formula I and a biplane class racer . . . but, he says, his heart is with the Unlimiteds.

Nor are airplanes Bruce's only game — both he and Pete Law have long been involved in unlimited hydroplane racing. They assisted in the installation of a RR Griffon in Miss Budweiser, for instance. Bruce has also dabbled in race cars, blown fuel dragsters and Bonneville streamliners . . . almost anything that goes fast!

Then, as a balancing counterpoint, he made a presentation in 1978 on hot air airships, as a representative of Boland Balloons, owned by his nephew, Brian Boland.

Currently, he is consulting on the installation of R-4360s in a couple of Sea Furies, one being built up by Frank Sanders and sons and another for Lloyd Hamilton.

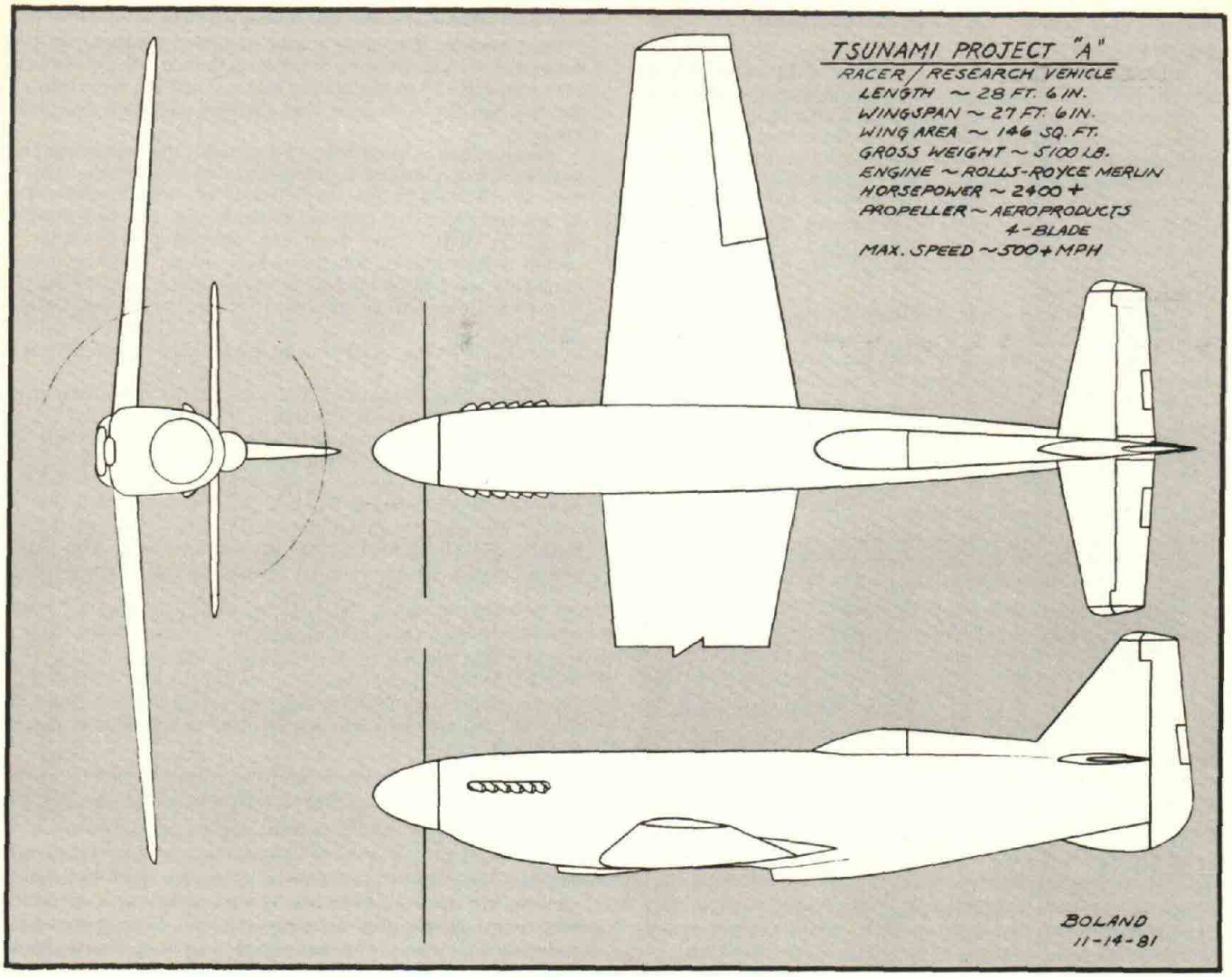
Now, believe it or not, all the foregoing activity has been accomplished in Bruce's spare time. His "real world" occupation is as an engineer for Lockheed, working in its Advanced Development Projects section . . . better known to the outside world as the legendary "Skunk Works" established years ago by Kelly Johnson. Precisely what Bruce does is, of course, in the "top secret" category. We do know that in years past, he has worked on such projects as the Polaris missile, the L-1011, SR-71 . . . and was once loaned out for a year to work on the Space Shuttle.

Bruce, who is only 44, is a native of that great aviation center — Brooklyn, Noo Yawk. He earned his bachelors degree in engineering from the Polytechnic Institute of Brooklyn . . . and moved to California in 1961 to go to work for Lockheed. Between 1963 and 1965 he attended USC, earning a Masters Degree in aerospace engineering . . . about the time his participation in air racing began. He worked as a structures engineer with Lockheed in his early years there and got his masters degree in aerodynamics — a combination that uniquely prepared him for designing the Tsunami, as well as his modification work on the warbird racers.

Bruce and his wife, Dorelle, live in Tujunga, CA, one of the zillion municipalities that make up Greater Los Angeles.

For all his accomplishments, Bruce has never been in aviation's spotlight — mainly because he is a team oriented person. During my interview with him, he **always** spoke in terms of "we" rather than "I". John Sandberg, Pete Law, Phil Greenberg and Ray Poe — and even Greg Benson who had just joined the group to help complete the racer on schedule — were always mentioned when past and present accomplishments were being enumerated. "It's a team effort," was perhaps the most recurrent phrase in our conversation.

An EAAer since the late 60s, Bruce Boland is certainly a fellow member all of us can be proud of. We wish he, John Sandberg and the entire Tsunami team success in the months ahead. It would be great to see the recip world's speed record set by a "homebuilt", wouldn't it?



the event of a blown engine and the seemingly inevitable oil spray that obscures the pilot's vision.

The coolant and oil radiators will be located up inside the fuselage, behind the pilot. An air inlet similar to that of a Mustang, but much smaller, is mounted in the belly. The cooling air outlets are just in front of the small ventral fin you see in the drawings. Interestingly, the vertical fin doubles as the oil tank . . . helping with CG considerations, Bruce says, as well as providing the more obvious surface cooling effect. The dual purpose radiator (one section for oil, the other for engine coolant) is being custom built . . . at **considerable** expense.

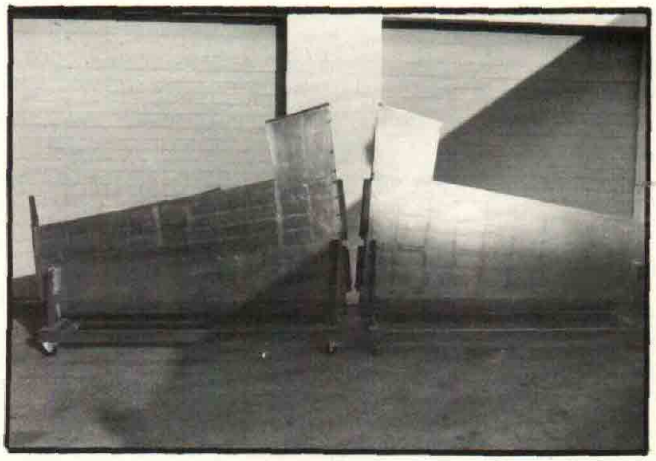
Tsunami's tailwheel unit is from a P-51H. It weighs only about 22 pounds and is physically small enough to fit in the racer.

As can be seen in the photographs, the all-metal construction of Tsunami is quite conventional . . . in fact, there is nothing **unconventional** about the airplane. Its moment arms, indeed the overall geometry, have been carefully tailored to produce what for a racer is a nice flying airplane. Bruce is of the opinion that even the most skilled pilot cannot wring out the maximum speed potential of an airplane if he is having to fight it every mile of the way . . . especially in pylon racing.

"If it handles well, it will go fast," is Bruce's succinct opinion on the matter.

The projected stall speed is around 85 mph and the touch down speed on landing will be about 105. Split flaps for drag only (and to lower the nose on approach) will be fitted.

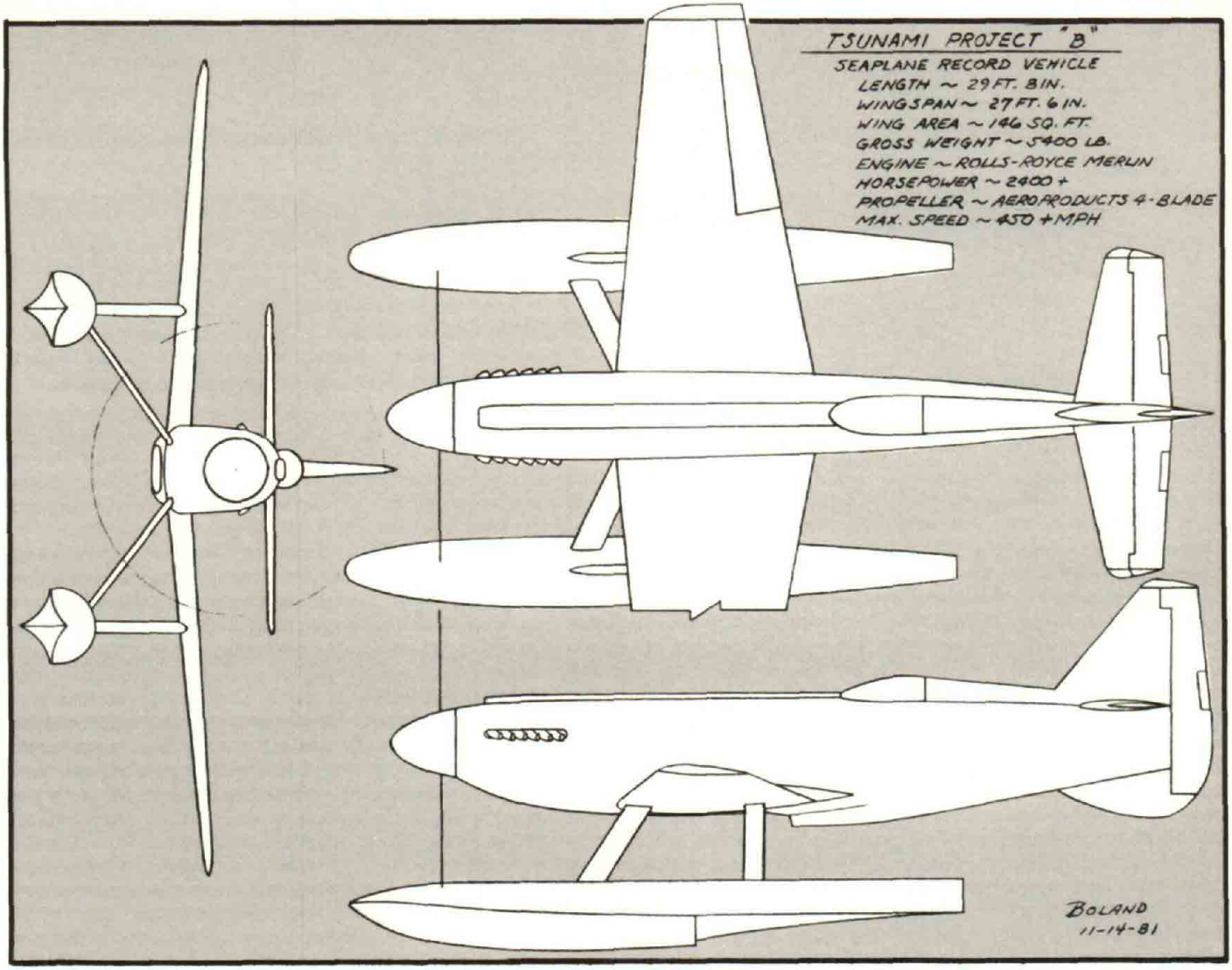
As stated earlier, I had the opportunity to visit the project in mid-February (in the company of Ken Brock). The airframe was being built in Phil Greenberg's shop in Chatsworth, CA — near the Van Nuys Airport. The wing will be one piece when completed, but has been built in 3 sections. The outer panels were essentially complete when we arrived and the center section was in the jig. A mock-up of the engine compartment had been built to fit the shortened mount and build the cowling. The "liquid bay", or center portion of the fuselage was in its jig and was being precisely

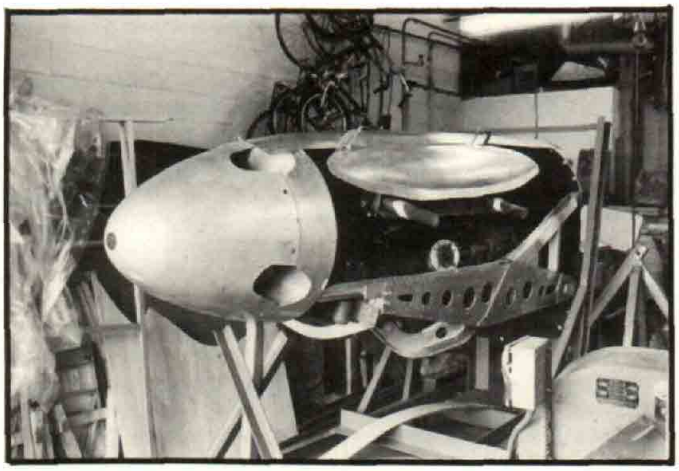


The outer panels of Tsunami's wing. They were subsequently mated to the center section to form a one-piece wing. With a span of 27' 6" and a wing root depth of 10.5", Tsunami's wing has a total frontal area of 17.3 square feet, compared to 34.9 for a stock Mustang. The design load factors are: positive — 8 Gs limit and 12 ultimate; negative — 4 Gs limit and 6 ultimate.

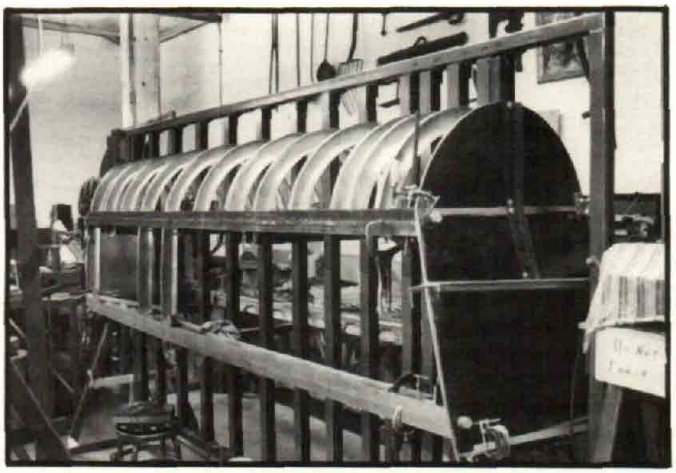
aligned by means of a laser. Bruce told me that the tail feathers were being built in his garage and were well along at the time. The remaining major part of the airframe, the aft fuselage, was in a stack on a work bench — all the parts had been made and were in the process of being deburred and cleaned up before being put in a jig for assembly.

According to Bruce, the schedule his crew was following called for completion of the airframe and transport to the Chino, CA airport by the end of May. There, in the shop of Ed Maloney's





Mock-up of the power section. Note the Mustang spinner and shortened Mustang engine mount. The frontal area of Tsunami's fuselage will be 9.8 sq. ft., compared to 12.6 for a Mustang. The engine shown here is simply a clunker being used to check for fit of various components.



The center portion (or "liquids bay", as Bruce Boland calls it) of Tsunami's fuselage just going into its jig. The cloth covered object at the right with the "Do Not Touch" sign is the laser with which precise alignment is accomplished. Note the sophisticated aircraft tools on the wall behind the jig.

Planes of Fame Museum, Tsunami will be assembled and the engine and systems installed. The in-joke among team members is that the electrical system will consist of **the** wire and the hydraulic system of **the** line . . . their way of expressing the utter simplicity of the machine. It was a matter of interest to me that, even with its 500 + mph speeds, Tsunami will stick with manually actuated control surfaces — muscle driven pushrods and torque tubes. No hydraulic boost is planned, although servo tabs will be employed, of course.

The initial test flight should occur sometime in June, so that a couple of months of flight testing can be accomplished before the Reno races in mid-September. Skip Holm and Tom Morgenfeld, both test pilots for Lockheed, were set to do the early flight evaluations, but a race pilot for Reno had not been selected at the time of my visit.

After Reno, the airplane will be prepared to assault the world's absolute speed record for piston engine airplanes. The pilot will be the owner, John Sandberg. John has never felt a personal need for more than a Private pilot's license, so it is for him a matter

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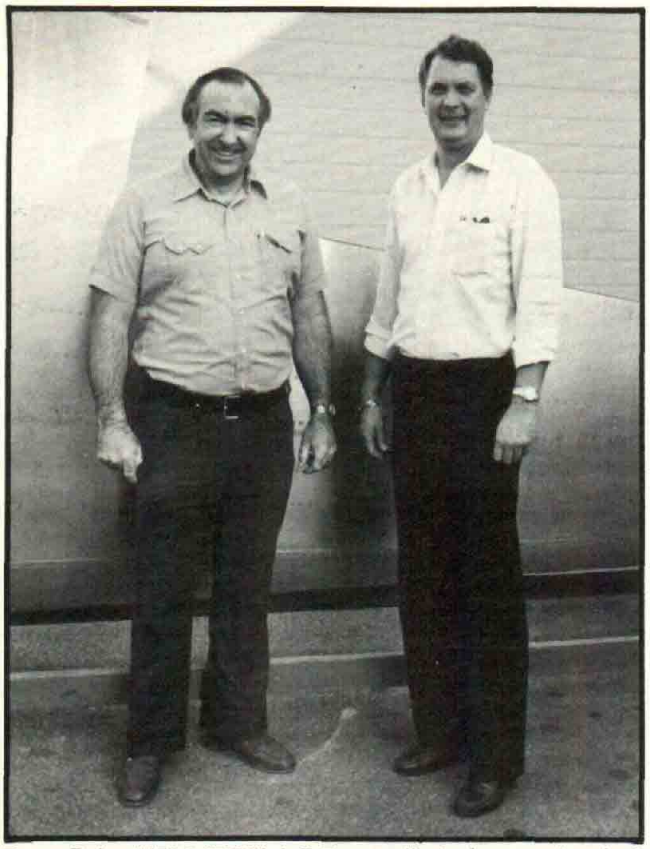

Bruce Boland (EAA 47238), left, Tsunami's designer and project manager, and John Sandberg (EAA 77857), the owner and engine builder. John will fly the airplane in the world speed record attempt. He and his JRS Enterprises, which specializes in overhauls of the older radials, Allisons and Merlins, have been most generous and helpful in keeping some of our EAA Museum aircraft flying.

Dorelle Boland came up with the name "Tsunami", so she gets to use it on her license plate.

TSUNAMI . . .

(Continued from Page 51)

of special, personal pride that the record be broken by a Private pilot. (Go for it, John!)

THEN . . . to answer your questions as to the reason for the accompanying drawing of the Tsunami on floats, yes, the team hopes to break the absolute world's speed record for seaplanes. The mark is 440.681 mph, set in 1934 by Italian Francesco Agello in the Macchi-Castoldi MC-72.

"We feel the Italians have held that record long enough," Bruce says with a little twinkle in his eyes.

For that attempt, the Tsunami's landing gear will be removed and its hard points will be utilized to attach the float struts. Bruce has already made a study of float design and, not surprisingly, has found those of the old Schneider Trophy racers to be very hard to improve upon. One edge may be the fact that the record will likely be attempted off the Great Salt Lake, so the unusually dense water there will permit somewhat smaller floats. In the early stages of the project, it was hoped the seaplane attempt could be made in 1984, the 50th anniversary of the Italian record, but this may not be possible. The landplane record has first priority after Reno so it may well be into 1985 before the seaplane configuration can be developed.

Several things should be stressed at this point, the first of which is the fact that although Tsunami is being privately financed and is being constructed by a small team of designer/builders, it is by no stretch of the imagination an "amateur" effort. The Boland/Law/Poe/Greenberg team is perhaps the most experienced in the racing business . . . and engines ARE John Sandberg's business. The airframe design is backed up with computer analyses, the printouts for which would fill a Sears catalog sized notebook. All-in-all, it is undoubtedly one of the most sophisticated **efforts** ever directed toward a racing aircraft . . . although the airplane, itself, is a very simple machine.

And, then, Tsunami is unique among racers in that a life after racing is planned for it. Ultimately, it will become a research aircraft, likely refitted with a turboprop engine so it can be used for near supersonic propeller testing.

All that's in the future, however. For now there's simply the excitement and anticipation of a truly competitive "homebuilt" unlimited air racer for the first time in 44 years. Can it really beat the modified Mustangs, the R-4360 powered Corsairs and Sea Furies?

Reno is going to be **VERY** interesting this year!