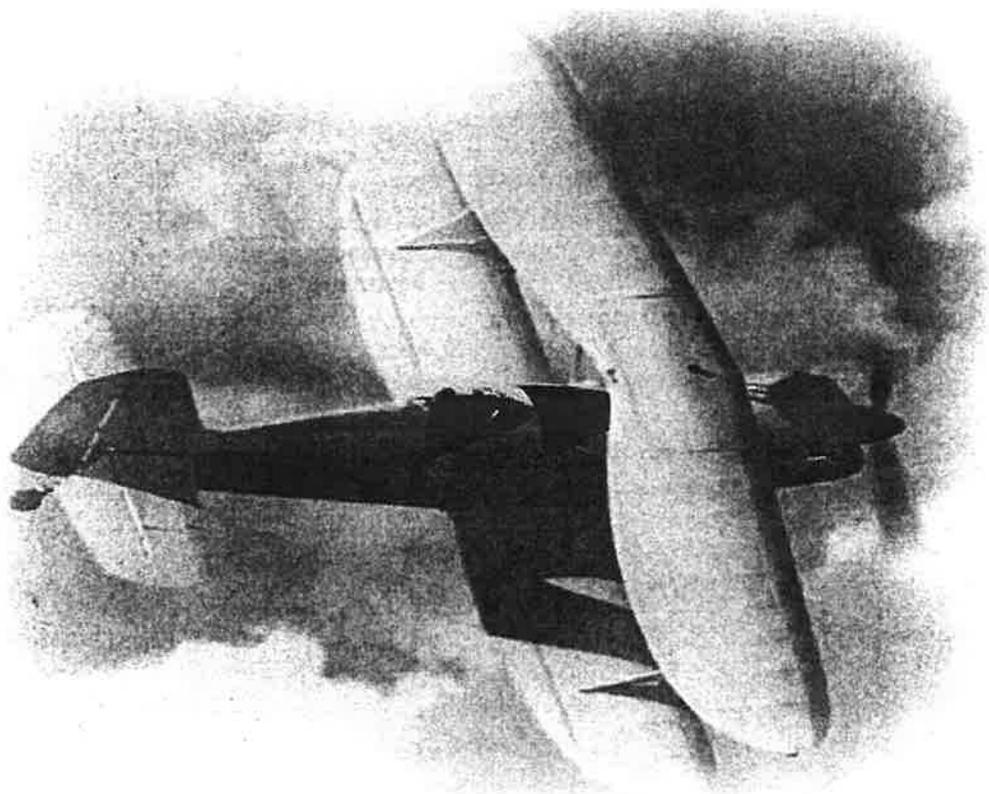


Starduster Too



SA300 Information Pack

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The **STARDUSTER TOO** was built to fill a need for a reasonably sized, two-place, open sport biplane. It was built to fly just for fun and is not intended to be an aerobatic airplane. It is quite strong, however, and many owners use the aircraft for aerobatic flight, but this is beyond the original concept of the machine. The aircraft is rated +/- 6G. Stability is good and the light wing loading makes slow landing speed and short-field operation outstanding. The main structure of the airplane is built of 4130 steel tubing and sheet stock and has no machined fittings or other complicated bends, which is an advantage for the average homebuilder with limited machine equipment to use. The wings have spruce spars and the ribs are made of 1/4" plywood using a modified M-6 airfoil. Construction of the plane has been kept as simple as possible and it goes pretty well.

The prints are quite complete with ribs and most fittings full size, which saves considerable time on construction of these parts.

The **O-360 Lycoming** is the best optimum size engine either in the 180 HP or the 200 HP version. Quite a few Starduster Too aircraft have been constructed with the Lycoming 10-540, with as much as 375 HP. There are Ranger powered, Ford V-8 and V-6 powered, Continental powered, Jacobs, and even some R-985 powered examples. The airframe is a proven unit and allows for many different types and kinds of engines. On the low end of the power curve there are some 125 HP aircraft in service. There are several aircraft with over 2,500 flying hours, and one with more than 5,000 hours.

All raw materials as well as certain prefabricated parts (such as fiberglass turtlebacks, nose cowls, wheel pants, cockpit cowlings, welded aluminum fuel tanks, plexiglass windshields, canopies, and so forth) are available at reasonable prices. The Starduster Too, when properly constructed, can be flown by any tailwheel pilot. It is easy and fun to fly, and the plane handles as well in the air as on the ground.

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STARBUSTER TOO PERFORMANCE DATA

SPAN, UPPER WING		24'-0"
SPAN, LOWER WING		21'-9"
INCIDENCE ANGLE, UPPER WING		0°
INCIDENCE ANGLE, LOWER WING		1°
DECALAGE		-1°
DIHEDRAL, UPPER WING		0°
DIHEDRAL, LOWER WING		1-1/2°
CHORD AT MAXIMUM POINT		48.0"
CHORD AT MAC		44.0"
WING GAP		47.0"
STAGGER AT MAX. CHORD POINT		+20.4"
WING AREA		165sq'
AIR FOIL		M-6
AIRFOIL ASPECT RATIO (THICKNESS/CHORD)		.120
THICKNESS/CHORD (FORM-6)		.120
WING LOADING @ MAX GROSS		10.27'
OVERALL LENGTH		20'-7"
OVERALL HEIGHT		7'-3"
G'S DESIGN LIMIT		±6.0
G'S ULTIMATE		±9.0
FUEL CAPACITY: WITH WING TANK	16.7	45 GAL
W/OUT WING TANK	28	28 GAL
ENGINE: LYC. 0-360-A1A (PREFERRED)		180-200 HP
RECOMMENDED ENGINE HP RANGE		150-300 HP
POWER LOADING AT MAX. GROSS		9.47 lbs/HP
WEIGHT:	EMPTY W/ ENGINE OIL	1,000 lbs
	FUEL (45 GAL @ 6.5 lbs/gal)	293 lbs
	PASSENGERS (2 @ 175 lbs ea)	350 lbs
	BAGGAGE & MISC	61 lbs
	MAX. AEROBATIC GROSS WT.	1,704 lbs
C.G.	MAX. FORWARD FROM FIREWALL	18.0"
	MAX. AFT OF FIREWALL	27.0"
	STALL SPEED @ 1,757# Vs	56 MPH
	MAX. SPEED Vne	180 MPH
	MAX. STRUCTUAL SPEED Vno	180 MPH
	CRUISE SPEED @ 75% POWER Vo	135 MPH
	CRUISE SPEED @ 60% POWER Vo	122 MPH
	MANEUVERING SPEED Va	105 MPH
	BEST GLIDE	70 MPH
	BEST GLIDE ANGLE	6-1/2°
	ABSOLUTE CEILING	23,000'
	BEST ANGLE OF CLIMB SPEED Vx	70 MPH
	BEST RATE OF CLIMB SPEED	83 MPH
	BEST CLIMB RATE: SEA LEVEL	1,500'/MIN
	5000' MSL	1,060'/MIN
	10,000' MSL	810'/MIN
CONTROL MOVEMENT:	AILERONS	+30° -18°
	ELEVATORS	+30° -25°
	RUDDER	±25°

DATA COMPLIED WITH LYCOMING 0-360-A1A, 180HP ENGINE.
 OPTIVM ENGINE-180 OR 200 HP LYCOMING 4 CYLINDER
 COMMON ENGINE 0-540 SERIES W/ LYC. 6 CYL. LIGHTER VERSION
 SMALLEST KNOWN ENGINE: 125 HP

Starduster Too SA300 Weight & (Example) Balance Work Sheet

Horizontal Datum: Top Longeron: must be level
 Vertical Datum: Firewall
 Forward C.G. Limit: 18.0
 AFT C.G. Limit: 27.0 Do not exceed

Empty Weight Calculations

Weighing Point	Weight	Distance	Moment
Right Main (R1)	540	13.5	7290
Left Main (R2)	538	13.5	7263
Tail Wheel (R3)	32	168	5376
Column Totals:	1110		19929
$D = \frac{D1 \times (R1 + R2) + D2 \times (R3)}{R1 + R2 + R3}$		18.0 Empty C.G.	

Max Forward C.G. Calculations

Weighing Point	Weight	Arm	Moment
Right Main (R1)	540	13.5	7290
Left Main (R2)	538	13.5	7263
Tail Wheel (R3)	32	168	5376
Pilot	180	68	12240
Fuel, Main	120	24	2880
Fuel Wing	16	-24	-384
Oil	16	9	144
Totals for ea. column	1442		34809
Total Moment:	34809		
Total Weight:	1442	24.1 Forward C.G.	

Max AFT C.G. Calculations

Weighing Point	Weight	Arm	Moment
Right Main (R1)	540	13.5	7290
Left Main (R2)	538	13.5	7263
Tail Wheel (R3)	32	168	5376
Baggage	10	84	840
Pilot			
CoPilot			
Fuel, Main			
Fuel, Wing			
Oil			
Totals for each column:	1546		41553
Total Moment:	41553		
Total Weight:	1546	26.9 AFT C.G.	

Notes: Distances given will vary with each aircraft. Verify exact dimensions to ARM's. *****
 The best way to determine the actual ARM is to weigh the aircraft and then install *****
 weights, example, pilot get in aircraft and re-weigh. A much less accurate method is *****
 to measure to center of where the ARM (center of weight load) will be. *****

**AERODYNAMIC
AND
STRUCTURAL ANALYSIS
OF THE
STARDUSTER TOO AIRCRAFT**

PREPARED FOR

MR. L STOLP
CORONA, CALIFORNIA

PREPARED BY

WILLIAM H. WEST
DECEMBER 31, 1969

INTRODUCTION

THE ANALYSIS OF THE "STARDUSTER TOO" AIRCRAFT PRESENTED HEREIN, WAS UNDERTAKEN AT THE REQUEST OF THE DESIGNER, MR. L STOLP, TO VERIFY THE PRELIMINARY ESTIMATES USED IN PREPARING THE DESIGN AND TO INSURE THE STRUCTURAL INTEGRITY OF THE AIRCRAFT WAS VALID FOR ALL GOVERNMENT SPECIFIED FLIGHT CONSTRUCTION.

SINCE THE ANALYSIS WAS PREPARED FOR AN EXISTING AIRCRAFT AND IS TO VERIFY THE STRUCTURE OF THE AIRCRAFT, RATHER THAN BE USED AS A DESIGN GUIDE, THE CRITICAL FLIGHT CONDITION SELECTED IMPOSES MATHEMATICALLY GREATER LOADS THAN THE AIRCRAFT WILL EXPERIENCE IN FLIGHT. THE ANALYSIS IS THEREFORE CONSERVATIVE IN ITS APPROACH.

WILLIAM H. WEST

**SECTION 1
BASIC AIRCRAFT DATA**

THE BASIC AIRCRAFT DATA HAS BEEN TAKEN FROM BOTH THE AIRCRAFT DRAWINGS AND FROM PREVIOUSLY CONDUCTED PERFORMANCE ANALASYS. THIS PERFORMANCE DATA HAS BEEN PROVEN TO BE IN CLOSE AGREEMENT WITH ACTUAL FLIGHT DATA, AND PROVIDES THE BASIS FOR SELECTION OF THE CRITICAL FLIGHT VELOCITIES.

FOR REFERENCE THE AIRCRAFT HAS BEEN DIVIDED INTO FUSELAGE STATIONS, WING STATIONS, AND WATER LEVEL STATIONS. THE DATUM PLANE FOR THE FUSELAGE STATIONS FOLLOWS THE PERFORMANCE DATA ANALYSIS IN SELECTING THE FIREWALL AS THE 0 DATUM PLANE. ALL FUSELAGE STATIONS AFT OF THE DATUM PLANE ARE POSITIVE AND ARE MEASURED IN INCHES. THE WATER LEVEL 0 STATION HAS BEEN SELECTED AS THE CENTER LINE OF THE MAIN WHEEL AXLE. STATIONS ABOVE THIS LEVEL ARE POSITIVE.

THE WING STATIONS ARE MEASURED FROM THE CENTER LINE OF THE AIRCRAFT AND ARE ASSUMED POSITIVE IN EITHER DIRECTION BECAUSE OF THE AIRCRAFT SYMETRY. A SLIGHT DEVIATION WAS MADE IN SELECTING WING STATIONS FOR THE UPPER WING BECAUSE OF THE REARWARD SWEEP. WING STATIONS USUALLY ARE MEASURED TO THE 25% CHORD LINE, AND BUTT (BUTTLOCK) PLANES ARE PARALLEL TO THE CENTER LINE. HOWEVER, BECAUSE OF THE SMALL DEGREE OF SWEEPBACK (6') BUTT PLANES AND WING STATIONS ARE CONSIDERED TO BE SYNONYMOUS.

STRENGTH OF THE STARDUSTER TOO

THE STRENGTH OF AN AIRCRAFT, i.e., ITS ABILITY TO WITHSTAND NORMAL AERO-DYNAMIC FORCES AS WELL AS THOSE ADDITIONAL FORCES DUE TO GUSTS, MANEUVERING OR LANDING IS USUALLY EXPRESSED IN TERMS OF A FACTOR OF THE ACCELERATION OF GRAVITY. THUS, AN AIRCRAFT MAY BE SAID TO WITHSTAND 5 OR 6 G's, MEANING 5 OR 6 TIMES THE NORMAL ACCELERATION OF GRAVITY. THIS FACTOR IS USED IN DETERMINING THE LOADS ON AN AIRCRAFT BY MULTIPLYING THE GROSS FLYING WEIGHT OF AN AIRCRAFT BY THE G FACTOR.

THE "G" FACTOR IS FURTHER DEFINED BY THE TERMS "LIMIT" AND "ULTIMATE". THE LIMIT LOAD IS THAT MAXIMUM LOAD WHICH WILL STRESS THE MATERIAL OR STRUCTURE TO ITS ELASTIC LIMIT. IF THIS LOAD IS REMOVED, THE MATERIAL WILL RETURN TO ITS ORIGINAL DIMENSION. ANY LOAD IN EXCESS OF THIS "LIMIT" WILL CAUSE A PERMANENT DEFORMATION OR "SET". THE "ULTIMATE" LOAD IS THAT MAXIMUM LOAD WHICH IF EXCEEDED WILL CAUSE FAILURE OF THE MATERIAL OR STRUCTURE.

THEREFORE, IF AN AIRCRAFT IS SPECIFIED TO BE A 6 "G" LIMIT AND 9 "G" ULTIMATE. AIRCRAFT, IT IMPLIES THAT THE AIRCRAFT CAN BE SAFELY FLOWN THROUGH MANEUVERS THAT WILL IMPOSE LOADS EQUAL TO 6 TIMES ITS NORMAL WEIGHT WITHOUT DEFORMING (STRETCHING, BENDING, ETC.) ITS STRUCTURE. IT CAN ALSO BE FLOWN THROUGH ACCELERATIONS EQUAL TO 9 TIMES ITS NORMAL WEIGHT WITHOUT FAILURE OF THE STRUCTURE. THE ABILITY OF AN AIRCRAFT TO WITHSTAND THE LIMIT AND ULTIMATE LOAD ARE STATED BY "MARGINS OF SAFETY". THE MARGIN OF SAFETY IS THE PERCENTAGE DIFFERENCE BETWEEN THE ACTUAL LOAD APPLIED TO A PARTICULAR STRUCTURAL COMPONENT AND MAXIMUM LOAD THAT A MEMBER CAN WITHSTAND. LIMIT MARGINS OF SAFETY ARE THEREFORE THE PERCENTAGE DIFFERENCE BETWEEN THE ACTUAL LOAD AND THE ELASTIC LIMIT OF THE STRUCTURAL MEMBER. ULTIMATE MARGINS OF SAFETY ARE THE PERCENTAGE DIFFERENCE BETWEEN 1.5 TIMES THE ACTUAL LOAD AND THE FAILURE LOAD OF THE STRUCTURAL MEMBER.

CRITICAL FLIGHT CONDITIONS & LOAD FACTORS FOR THE STARDUSTER TOO

THE STARDUSTER TOO IS A 6 "G" LIMIT, 9 "G" ULTIMATE AIRCRAFT IN BOTH NORMAL AND INVERTED FLIGHT. THE CRITICAL, i.e., MAXIMUM LOADS ARE IMPOSED BY CONDITION I - A SUDDEN PULL UP TO MAXIMUM ANGLE OF ATTACK AT MAXIMUM LEVEL FLIGHT AND CONDITION V - INVERTED FLIGHT AT MAXIMUM ANGLE OF ATTACK.

CONDITION I - 6 "G" LIMIT, 9 "G" ULTIMATE.

CRITICAL MEMBER - SPAR TO CENTER SECTION ATTACH FITTING - PART NO. 41.
CRITICAL IN BEARING STRESS.

MARGIN OF SAFETY (BEARING ULTIMATE) = .02.

ACTUAL ALLOWABLE ULTIMATE "G" FACTOR AT 0 MARGINS IS 9.18 "G's".

THE SECOND MOST CRITICAL MEMBER IS THE FRONT SPAR ACTING UNDER COLUMN LOAD.

MARGIN OF SAFETY (COLUMN ULTIMATE) = .18.

ACTUAL ALLOWABLE ULTIMATE "G" FACTOR AT 0 MARGIN IS 10.6 "G's".

MINIMUM COMPONENT FOR LIMIT LOAD FACTOR IS SPAR BENDING UPPER WING FWD. SPAR AT THE INTERBAY STRUT ATTACH POINT.

MARGIN OF SAFETY (LIMIT) = .29.

ALLOWABLE ACTUAL LIMIT "G" FACTOR AT 0 MARGIN IS 7.74 "G's".

CONDITION V INVERTED FLIGHT

THE LIMITING COMPONENT FOR INVERTED FLIGHT IS THE STRESS IN THE LANDING WIRED ACTING AS FLYING WIRES.

MARGIN OF SAFETY (LIMIT) = .95.

ACTUAL ALLOWABLE "G" FACTOR AT 0 MARGIN IS 8.27 G's.

MARGIN OF SAFETY (ULTIMATE) = .50.

ACTUAL ALLOWABLE "G" FACTOR AT 0 MARGIN IS 10 "G's".

THE ABOVE INFORMATION INDICATES A REASONABLY STRONG AIRPLANE, BUT IT IS NOT INTENDED TO BE AN AEROBATIC AIRCRAFT. ALSO, TAKE NOTE THAT THE STRESS INDICATED WAS RUN AT 1704 LBS., WHICH WAS THE WEIGHT OF THE ORIGINAL STARDUSTER TOO WITH A 180HP LYCOMING ENGINE, FIXED PITCH PROPELLER AND NO ELECTRICAL SYSTEM. ADDED WEIGHT WILL EFFECT BOTH THE STRESS AND PERFORMANCE OF THE AIRPLANE.

THE "g" FACTOR IS FURTHER DEFINED BY THE TERMS "LIMIT" AND "ULTIMATE". THE LIMIT LOAD IS THAT MAXIMUM LOAD WHICH WILL STRESS THE MATERIAL OR STRUCTURE TO IT ELASTIC LIMIT. IF THIS LOAD IS REMOVED, THE MATERIAL WILL RETURN TO ITS ORIGINAL DIMENSION. ANY LOAD IN EXCESS OF THIS "LIMIT" LOAD WILL CAUSE A PERMANENT DEFORMATION OR "SET". THE "ULTIMATE" LOAD IS THAT MAXIMUM LOAD WHICH IF EXCEEDED WILL CAUSE FAILURE OF THE MATERIAL OR STRUCTURE.

THEREFORE, IF AN AIRCRAFT IS SPECIFIED TO BE A 6 "g" LIMIT AND 9 "g" ULTIMATE AIRCRAFT, IT IMPLIES THAT THE AIRCRAFT CAN BE SAFELY FLOWN THROUGH MANEUVERS THAT WILL IMPOSE LOADS EQUAL TO 6 TIMES ITS NORMAL WEIGHT WITHOUT DEFORMING (STRETCHING, BENDING, ETC.) ITS STRUCTURE. IT CAN ALSO BE FLOWN THROUGH ACCELERATION EQUAL TO 9 TIMES ITS NORMAL WEIGHT WITHOUT FAILURE OF THE STRUCTURE. THE ABILITY OF AN AIRCRAFT TO WITHSTAND THE LIMIT AND ULTIMATE LOAD STATED BY "MARGINS OF SAFETY". THE MARGIN OF SAFETY IS THE PERCENTAGE DIFFERENCE BETWEEN THE ACTUAL LOAD APPLIED TO A PARTICULAR STRUCTURAL COMPONENT AND MAXIMUM LOAD THAT MEMBER CAN WITHSTAND. LIMIT MARGINS OF SAFETY ARE THEREFORE THE PERCENTAGE DIFFERENCE BETWEEN THE ACTUAL LOAD AND THE ELASTIC LIMIT OF THE STRUCTURAL MEMBER. ULTIMATE MARGINS OF SAFETY ARE THE PERCENTAGE DIFFERENCE BETWEEN 1.5 TIMES THE ACTUAL LOAD AND THE FAILURE LOAD OF THE STRUCTURAL MEMBER.

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CONDITION I: 6 "g" LIMIT, 9 "g" ULTIMATE:

CRITICAL MEMBER -SPAR TO CENTER SECTION ATTACH FITTING, PART NO. 41.

CRITICAL IN BEARING STRESS.

MARGIN OF SAFETY (BEARING ULTIMATE) = .02

ACTUAL ALLOWANCE ULTIMATE "g" FACTOR TO 0 MARGIN IS 9.18 "g's".

THE SECOND MOST CRITICAL MEMBER IS THE FRONT SPAR ACTING UNDER COLUMN LOAD.

MARGIN OF SAFETY (COLUMN ULTIMATE) = .18

ACTUAL ALLOWABLE ULTIMATE "g" FACTOR AT 0 MARGIN IS 10.6 "g's".

MINIMUM COMPONENT FOR LIMIT LOAD FACTOR IS SPAR BENDING UPPER WING FWD.

SPAR AT THE INERBAY STRUT ATTACH POINT.

MARGIN OF SAFETY (LIMIT) = .29

ALLOWABLE ACUTAL LIMIT "g" FACTOR AT A 0 MARGINIS 7.74 "g's".

CONDITION V: INVERTED FLIGHT:

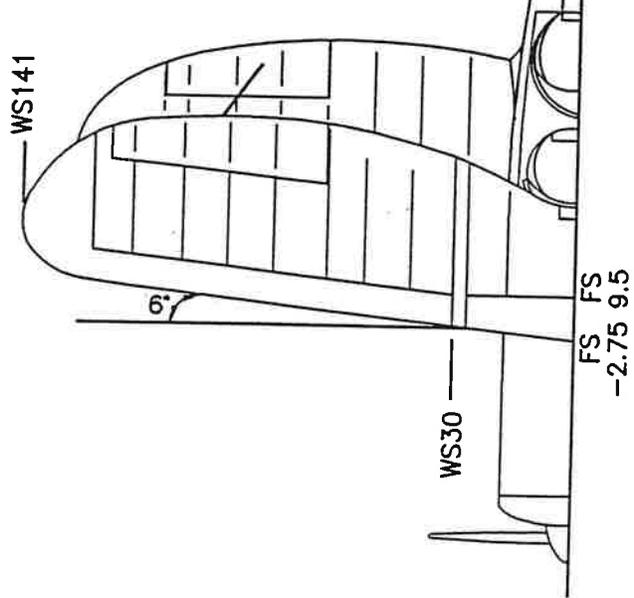
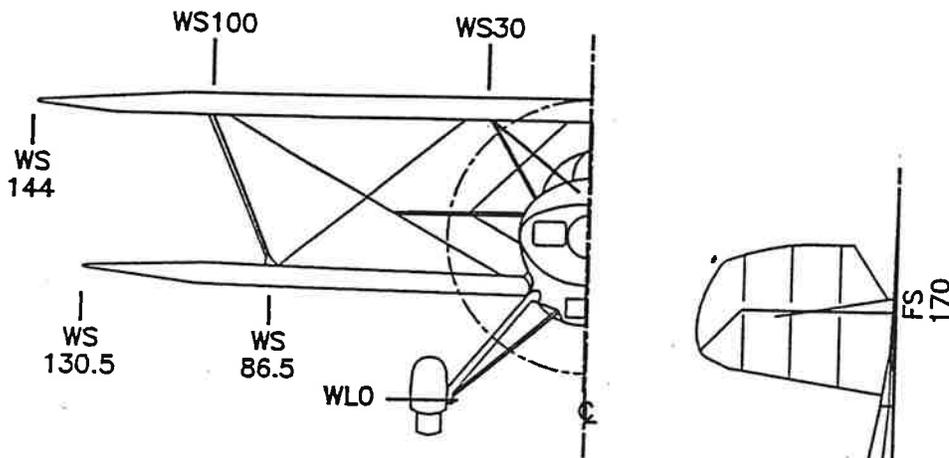
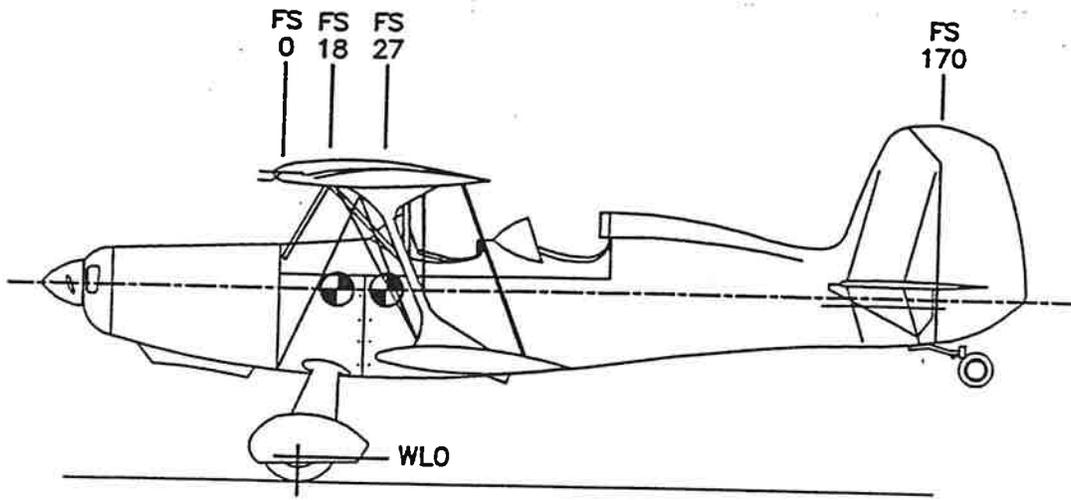
THE LIMITING COMPONENT FOR INVERTED FLIGHT IS THE STRESS IN THE LANDING WIRES ACTING AS FLYING WIRES.

MARGIN OF SAFETY (LIMIT) = .95.

ACTUAL ALLOWABLE "g" FACTOR A 0 MARGIN IS 8.27 "g's".

MARGIN OF SAFETY (ULTIMATE) = 50.

ACTUAL ALLOWABLE "g" FACTOR AT 0 MARGIN IS 10 "g's".



AIRCRAFT GEOMETRY
 STARDUSTER CORPORATION



Starduster Too SA300
Q & A
Frequently Asked Questions

Aircraft Spruce & Specialty Co.
877-477-7823 (Sales Line)



Starduster Too SA300

FREQUENTLY ASKED QUESTIONS:

Why is the Starduster Too also identified as a SA300?

The Starduster Too is called SA300 after the two people instrumental in the aircraft, Lou Stolp and George Adams, (SA). Jim Osborne changed the SA to mean sport Aerobatics.

Landing gear problems, what is this about?

The early Starduster Too's had landing main landing gear placed approximately 1 3/4" behind the fire wall reference line. This resulted in a very heavy tail wheel. These aircraft, especially if main landing gear was not lined up with no toe in or toe out would have tail wheel problems. Tail wheel shimmy, and bent, busted mountings were possible. If the main gear was not lined up properly you could have a craft, which was great in the air but a bear to handle on the ground. Another complicating factor was the early Too's had short engine mounts and added even more to the heavy tail wheel problem.

The early landing gear was not strong enough and with side loads, such as encountered in a ground loop, would tend to fold up. Many of these gears had round tubes placed inside the streamline tubing to strengthen them. When the gear was moved back to the present 8" location it was strengthened and additional bracing struts were installed. If you fly a Too with the old gear and then again with new gear the differences are major.

Engine mount lengths and Center of Gravity problems?

Early Starduster Too's had an engine mount which placed the engine approximately 12" from the firewall. This is based upon the Lycoming 0-360 series engines. Results were the aircraft was at or exceeded aft CG limits under most conditions. It is not uncommon for these aircraft to have stories of strange stall characteristics and even go into a flat spin during certain aerobatic maneuvers. It also contributed to the heavy tail wheel problems.

The current engine mounts for Lycoming 0-360 series engines are in the 24 to 27 inch range, back of engine to firewall. This keeps the CG within limits under most all conditions. If you fly a Too with an old short mount and then again after changes have been made to lengthen the mount you will be delighted. It does make a major difference.



What engines can I use for my Starduster Too?

Engines installed in the Too include most every engine from 125 horsepower through 300 horsepower opposed air-cooled Lycomings, Continentals and Rangers. Radial engines include most engines up to the Pratt and Whitney R-985. There are some Russia M14P engines being installed of 360 horsepower and several have pumped up Lycoming IO-540 series of up to 375 horsepower. The ideal engines are the 180 or 200 horsepower Lycomings. There are several for 302 V-8's, some V-6's flying and some Chevy 350's under construction.

The Starduster Too is a large plane with a proven history and is fit for most any engine would be interested installing.

I am thinking about buying a Starduster Too. What are the most important items to be concerned about?

There are several things to be concerned about. These lists will include several but not necessarily all. Check the aircraft over very well. Enlist the aid of a Starduster Too Builder or A&P if possible. Things to check at this point include craftsmanship for safe work. Check weld, woodwork, fabric work, attachments, bolt and safety pins, electrical, fuel, oil systems, landing gear and brakes. Check the controls for looseness. Have someone hold the stick stationary and move the elevator up and down. There should not be any movement. Move ailerons up and down with stick held stationary. There will probably be little play here, find out where it is coming from, worn aileron hinges, loose rod ends, loose bell crank bearings. Hold the lower aileron stationary and move the upper aileron. Is there Play? Where is it coming from, rod end bearings, rod ends?

Check the flying wire tension by striking them with the side of a finger. The sound should be the same from all wires. Look for any scratches, marks or damage to the flying wires. Check the javelin for rubbing, same thing with fairings or covers at wing coverings. Any damage here and the wires should be replaced. This is what is holding the aircraft wings in place and damage leading to fractures and failure will ruin you whole day.

Check the ailerons. Is it possible to push down on the upper aileron and lock it over center. Many Toos are build without stops on ailerons and are rigged in such a way to allow ailerons to over center. Not very likely to happen unless in a tail slide but could ruin you day. Stops can be installed and if the condition exists must be installed.

Travel of all control surfaces needs to be checked. Make sure ailerons move the same distances up and down on each side. Check out trim tab operations. Some elevator trim tabs are set up only as trim tabs while others are set up as servo tabs to lighten stick loads. Either is ok.

Check the logbooks and talk to anybody who has flown the aircraft. Don't forget to find out how many times a year flew and what their flying experience is. There has been more than one Too owned by a high time pilot with lots of flying experience who has horror stories about



the airplane. On closer investigation the plane was flown typically 10 hours per year and in between hanger flying was all the other experience. And by the way the pilot flew piper cubs back in the 50's and this was his only tail wheel experience. New Owner finds no problems and logs 200 to 300 hours per year. Experience and practice makes a difference. This is not to say some stories are not justified.

Check for landing gear, old style or new. If it the old style it may be ok and is not to be written off just because it is the old style. Check it out. Check out engine mount length, is it the old short one approximately 12" or one of the newer, 18" or more. If you have the early landing gear and short mount, seriously consider changing them to the newer. If you have a heavy engine the old style landing gear sometimes works better than the new.

One of the most important things to check out is weight and balance. Do not believe the posted or log book data. Have a weight and balance performed before you do any aerobatics or spins. The reference is the firewall. CG limits are 18 to 27 inches. I know of at least one Too which looked like no changes had been made since it first flew and when a weight and balance was performed it was nearly 300 pounds heavier than data in logs and on name plate. Fortunately it was fairly evenly located, it would not have taken much distance with this weight to create problems.

During flight tests the aircraft should not show any tendencies to drop off on a wing during a stall. During 90 Degree bank stalls it should not drop off. Entering a power off stall slowly, you should feel one wing and then the other as they stall. Spins should not be any more eventful than something should like a Citabria or Decathlon. Just a tad bit faster rotation. You should get a notice on the stick just prior to stall. It can be slight so if you are excited you may not notice it at first.

Fuel management valving and plumbing should be something that makes sense to you. There is a main tank in the fuselage and in most Toos there is a wing tank. The main tank may or may not have an inverted system. The main tank may have only a shut off or it may have a method of changing from main tank section to inverted sump section. The top tank may drain into the main tank or be routed directly to the engine.

All engine oil and fuel screens must be checked at some point before you fly very much. Check out the gascolator and make sure it is clean and gaskets are in good shape. Check fuel and oil hoses. Place rear of the aircraft in a ditch and drain out all the fuel. Determine how much is left and then fill it up to determine how well the fuel level system works and how much fuel is actually held in each tank.

Check the landing gear mains to make sure there are not toeing in or toeing out, wheels must point straight ahead and must be parallel when viewed from above. Check out the safety cables on landing gear. They are intended to prevent a wing from dropping to the ground in event of a bungee break. If they are too tight and you make a HARD landing it is possible to take out the bungee truss.



When you get a change check the rigging with a accurate level or transit.

What type of windshield is best?

All types are in service. The most popular are the straight formed and the bubble type, both have their supporters and either works fine. If you cover up the front cockpit during cold weather when you are alone it sure makes a difference.

Where do I put baggage?

The main baggage area in the Too is the turtle back behind pilots head. If you have a long mount or heavy engine many people have added baggage areas behind the pilots seat. It is also possible to place a bag below passengers legs, in front of stick. If you are serious about baggage room Starduster has a baggage pod, which gets installed under the belly like a drop tank or bomb. Depending upon landing gear type and exhaust piping you may be able to install two pods.

I have carried my tools in a heavy canvas bag wire tied to the engine mount for years. This gets them out of the way and helps out CG.

Can I do aerobatics?

The Starduster Too is rated for plus/minus 6 G. Most fun aerobatics are a piece of cake. It is not as fast as a Pitts or Eagle but helps you develop coordination skills. The M-6 airfoil is fun to fly and I have really enjoyed it. If you like to do extended tail slides you should have additional elevator hinges installed. Lou Stolp did not promote the Too as an aerobatic aircraft but over the years it has enjoyed much success. There have been several air show performers using the Too, most notably Al Pietz, you may have seen him at Oshkosh. For a good aerobatic mount you will need at least 180 hp, 200 is better, inverted oil and fuel system and some altitude. Make sure you have been checked out and are qualified.

Aerobatic maneuvers that can be performed in a Starduster Too include but are not limited to: loops, rolls, slow rolls, barrel rolls, point rolls, aileron rolls, inverted flight, Dutch rolls, Cuban eight's, reverse Cuban eight's, immelmans, snap rolls, tail slides, hammerheads, clover leaf, chandelles, wingovers, lazy eight's, split S, spins both upright and inverted, standard, accelerated and flat. By combining maneuvers you can add an unlimited quantity of aerobatics. Examples include loop with roll on top, loop with roll on top and roll on bottom, split S on 45 degree up line. Let your imagination run wild.

What bungees do I install for a 180 or 200 hp Lycoming?

Two 1280HD, and when they get weak either replace or add one 1080. This is two per side and then add one per side. The HD stands for heavy duty.



What bungees do I install for a 0-540 series Lycoming?

Two 1280HD's and one 1080 are required.

What is the difference between the Starduster Too and Acroduster Too?

The Acroduster Too is approximately 10% smaller than the Starduster Too. Airfoil on the Starduster Too is an M-6 and the Acroduster Too is a Modified 2412 Symmetrical airfoil. The Acroduster Too is made for Aerobatics and is a high performance machine. Roll Rates are in the 360 degrees per second range with a G rating of +/- 9 while the Starduster Too has a roll rate of approximately 120 degrees and a G rating of +/- 6. People and baggage room is greater in the Starduster Too. If you want a high performance biplane primarily for aerobatics the Acroduster is for you. If lots of fun, easy flying, room and cross-country flying with fun aerobatics once in the while are what you want the Starduster Too is best.

What is the difference between the Starduster Too and the Skybolt?

Major differences include shape of wings, straight versus elliptical and pylon upper wing mounting versus cabane. Fuselages are almost identical with changes in covering shape and landing gear. Space in the aircraft and engine options are similar. Airfoils are different with the M-6 on the Starduster Too and a symmetrical on the Skybolt. Roll rates on the Skybolt will be faster with aerobatic qualities more similar to a Pitts. If you are intending to do a lot of aerobatics with just a little general flying you may lean towards the Skybolt, however if you want lots of fun, beauty, good handling and aerobatics not at a prime goal the Starduster Too is for you. One large consideration to be aware of is the cabane versus pylon upper wing mounting in that the cabane type leaves forward visibility free. Pylon type mountings place structure in your forward vision. From a strength stand point there is no difference. You will hear lots of pro and con on the strength aspect but when properly designed they are the same.

Are there more than one type of cabane on the Starduster Too:

Yes. There are two, the bolt on and weld on type. One is not better than the other and both are acceptable.

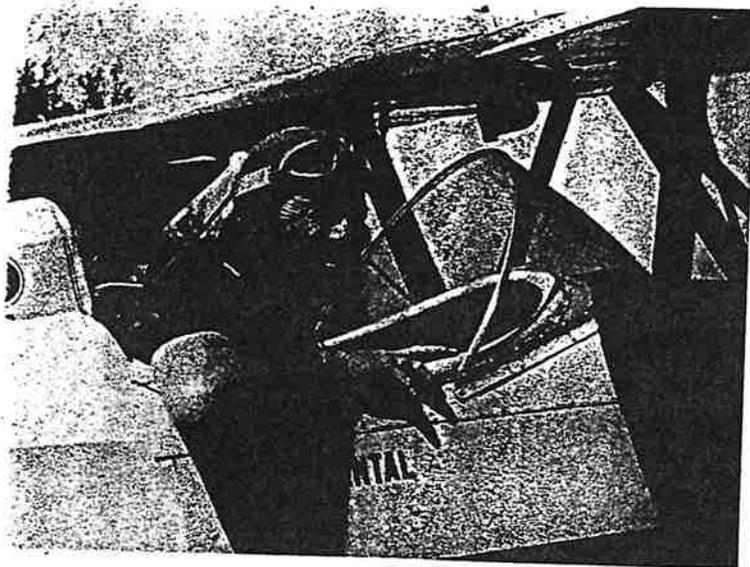
What is the best tail wheel to use?

The Scott 3200 tail wheel is one of the most popular however you will find many other tail wheels including the Scott 2000, Maule's, both large and small and about all other units made. To prevent shimmy it is essential to have tail wheel post over center to proper angle, even when loaded. Tail wheel success is having the proper main landing gear, new style, and not excessive weight on tail wheel. Main gear alignment is also critical for proper tail wheel operation.

Starduster Too SA300



Magazine Article Archives



This Is Really Flying

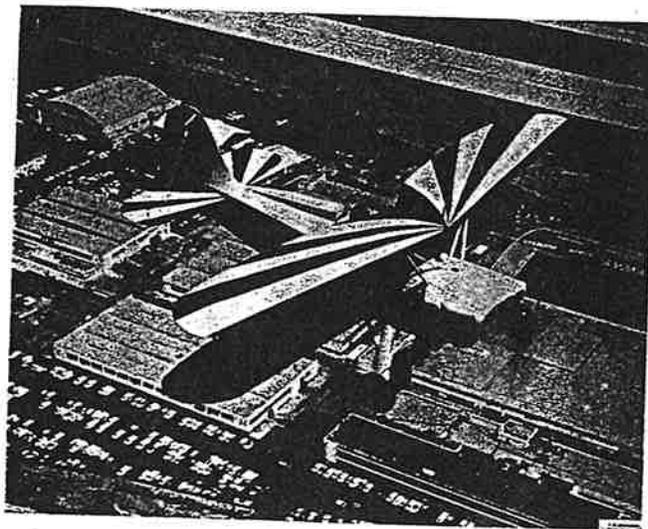
By John Tucker
3100 Goodard Way, San Diego 1, Calif.

WHEN THE alarm went off at 5:30 A.M., I was about ready to chuck the whole idea of flying my "Starduster" three-fourths of the way across the United States just for the fun of attending the Annual Experimental Aircraft Association Fly-In. This meet was being held in Rockford, Ill., and had already been in progress for three days. I hadn't been able to get away any earlier because of my flight schedules with the Airline. In fact, I was in San Francisco this morning — 500 miles away from home and my "bird." After the usual morning shave, dressing, checking weather and loading the passengers, we were ready for departure when one of the passengers brought up a note which he had found in a phone booth next to the loading ramp. In short, the note implied there was a bomb on board the aircraft. Well, that just about did it — passengers were off-loaded, aircraft searched and baggage ruffled to no avail. Two hours later, the FBI released the flight and we finally became airborne around 9:30 A.M. Let's see now, we'll arrive in San Diego about 11:00, 30 minutes to pack and drive out to the airport, another 30 minutes for the TV cameramen for a royal send-off, and I could be on my way by noon. With a little luck, I could be in Albuquerque, New Mexico by nightfall. A fast weather check with Paso Robles radio assured me I would have good weather en route so I decided to make the trip as planned.

A fast stopover in Los Angeles and a short 20 minutes later I was on my way home. Packing occupied the allotted time and the drive to the hangar was on schedule. Oh, yes, better pick up that omni indicator and converter and slip it into the hole already prepared for it. The omni head had been sent to the factory for overhaul and I had been assured that it would be returned in time for my departure. If not, the radio shop had an alternate instrument for substitution. Nope, the mail hadn't arrived yet so I grabbed the other omni and headed for the hangar with the cameraman close on my heels. It clipped right into place and looked real fine. When to my horror I realized the cables were all wrong for this instrument. Nothing to do but to remove it and go without navigational aids. This would be the pay-off, an airline pilot flying cross-country in an open cockpit biplane. with no instruments and no omni—how low could I sink? It was decided that I would stop over at the factory (if I could ever make it that far) and pick up a new omni head there. At least, I could navigate home via radio!

The local Chapter Flag Presentation, a few smiles for the camera and a goodbye wave to my family were the

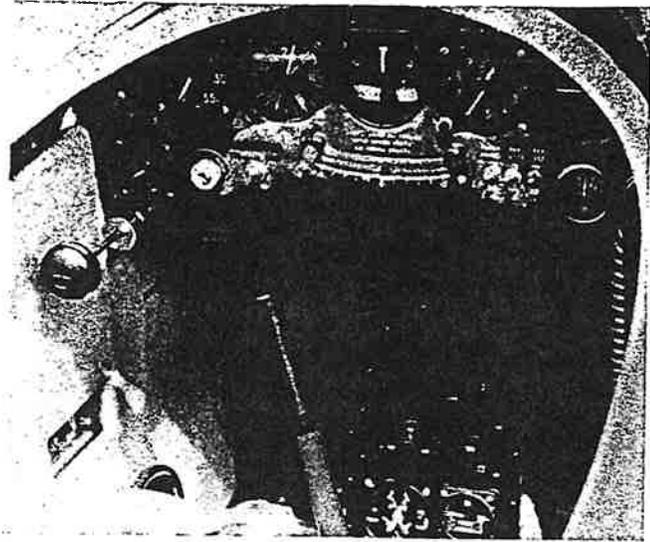
last of the formalities and the "bird" and I were together and on our way at last. Owning the Starduster is about as close to being married as one can get, she has such a wonderful personality and is perfectly suited to me. Several months earlier I had "clobbered" my new Mooney MK21 when the McCauley propeller had severed one blade about 8 inches from the hub in mid-flight over the mountains. The engine had torn loose and pretty well had torn up the front end of the Mooney, but I was able to land the remains safely in the desert. It was on one of the subsequent salvaging trips in my auto that I first spotted the Starduster. She was sitting out on the line



at the Corona, Calif. airport, prop removed, paint faded and top fabric starting to split apart at the ribs. She was the prettiest thing I had ever seen. I talked with Lou Stolp, the builder, and shortly had made a deal with him to patch it up for a ferry flight—I had acquired a new airplane.

Several months later and lots of money and work found her completely rebuilt, modified with an inverted fuel system, and a sparkling yellow and red paint job announcing she was ready to go again. This was the start of the love affair. I had added a complete electrical system, starter, generator, battery and KI100 radio — we were independent except for each other.

Ten minutes after take-off found us crossing the Cuyamaca Mountains, and heading out over the desert



for El Centro, Yuma and Phoenix, Ariz. The air was clear as a bell and navigation was no problem, just follow the lonely highway and railroad track across the barren country. I landed at Sky Harbor Airport and taxied up to the ramp for fuel. The temperature was 108 degrees so I proceeded to the air conditioned lounge for a "coke" while they refueled. That was the last time I let someone else gas my airplane. Through no one's fault but my own, the gas man had filled the wing tanks first, and as he was fueling the main tank in the fuselage, all the wing fuel drained down into it. Naturally there was severe overflow (about 12 gallons) and it all went into the cockpit and the radio gear. He came running down the ramp, waving frantically for help when I spotted him. I immediately realized what had happened and ran out to cap-off the tank and turn off the wing tank valves. To make a long story shorter, I mopped, wiped and blew fuel out of my airplane for two hours in the hot sun before I dared fire up the radio, or start the engine.

We finally departed Phoenix with just enough time to make Albuquerque by dark, allowing 30 minutes for safety. The weatherman said thunderstorms and rain over the mountains but clear weather on the other side. Never realized before just how accurate our forecasters really can be — the thunderstorms were there — and rain, wow! Within 15 minutes I was dodging rain squalls, flying between lightning strikes, and flying down the canyons in order to keep track of my dead-reckoning navigation. This was a 380 mile stretch through the mountains, with no means of navigation except an occasional mine, river, or wagon trail which showed up periodically on the sectional chart. There were two airports about 20 miles apart and about midway to Albuquerque so I figured I could set down at one of them if necessary.

I have never in my life worked so hard trying to keep track of my position and trying to remember all the little tricks about map reading that I had forgotten in the past 15 years of airline flying. I could hardly wait to get back into my Electra Jet with its dual ADF, dual omni and dual this and that! Guess I could have gone around on the southern route and followed the highways but that would have added an extra 50 miles, and ruined my plans for my schedule. I had only six days and wanted to get the most out of them—besides, I'm an airline pilot and this route is like shooting fish in a barrel. Ha! At my halfway ETA, sure enough there was an airport ahead of me right on schedule. Over the town and on an easterly course, the secondary road took a sharp turn to the south and I was suddenly lost. Nothing checked out, and the peaks didn't appear to be where

they should be. (They weren't, either). I swallowed my pride and turned back to the small airfield where I landed and inquired as to my whereabouts.

Sure enough, I had drifted off course about 10 miles and had overheaded the wrong airport. A few moments later, I was again on my way in the right direction and made Albuquerque just at sunset and with about 2 gallons of gas in my reserve tank. That was too close, and next time I'll go the long way and remove all the doubts about navigation. Early the next morning all I had to do was follow a single highway about 200 miles long, and not a turn in sight the whole length. The sun was up very bright and an occasional cumulus cloud drifted by to give the effect of a perfect flying day. Every once in a while I would find I was talking out loud and discussing with myself just how wonderful it was to have such a beautiful day and to be able to hear the wind sing in the wires. I would suddenly make a steep turn and observe the ground go by—then come back on course simply because it was fun and I had to express my feelings some way. On occasion I would slow-roll the "bird" and holler out to the wind that "this was really flying." Sound corny? Let me assure you, it really happened that way!

The next stop for fuel was Tucumcari, New Mexico. A fast hamburger, and another weather check promised the rest of the day would be perfect. Next city was Amarillo, Texas, then on up to Gage, Okla. Here there were an abundance of check points and some really beautiful scenery to watch go by as we proceeded on our way. The further north we went, the greener the grass became, and I was surprised at the amount and number of woods I flew over. We have trees in California, lots of 'em but not like this. Slashes of brilliant red mixed with the huge fields of golden wheat marked the approach of Kansas. I spent the night in Olathe, Kans., where I contacted King Radio Corp., and made arrangements to pick up my omni the next morning. Another perfect day dawned and with the radio checked out, "Starduster" and I headed northeast for the last leg of our journey. For awhile, in the Kansas City area, I thought we would have to land and wait out poor visibilities due to smoke and haze, but it cleared up within a matter of seconds after leaving the metropolitan city



behind. White fluffy bursts of fair weather cumulus and a startling blue sky prompted me to fly "on top."

Here again, it was a feeling beyond description to fly up among the clouds—a short stretch on top and then the descent back to the checkerboarded terrain below. I did this two or three times, then settled down to serious flying. I stopped over at the Ottumwa, Iowa airport where I had learned to fly in the 30's and had operated the field for a short time before the outbreak of the war. I had a chance to renew old acquaintances, fuel up and

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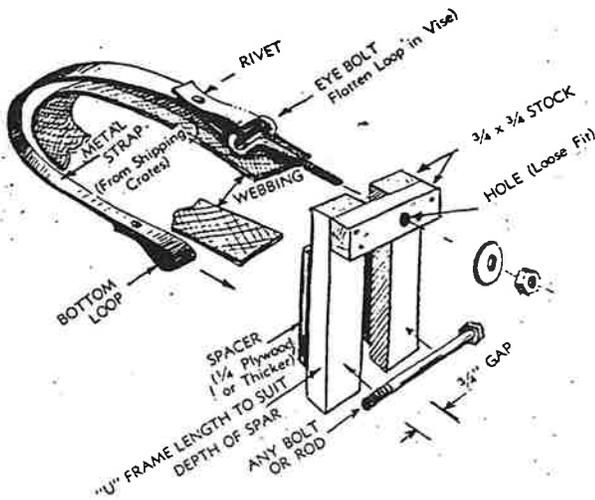
Leading Prop Edge Clamp

By Maj. Antoni Bingelis, EAA 2643
1111 Carlos Dr., Lincoln 5, Nebr.

THE EXTRA effort taken to insure a good joint when gluing the leading edge skin to flaps, ailerons, or even wings, will help insure maximum strength of structure.

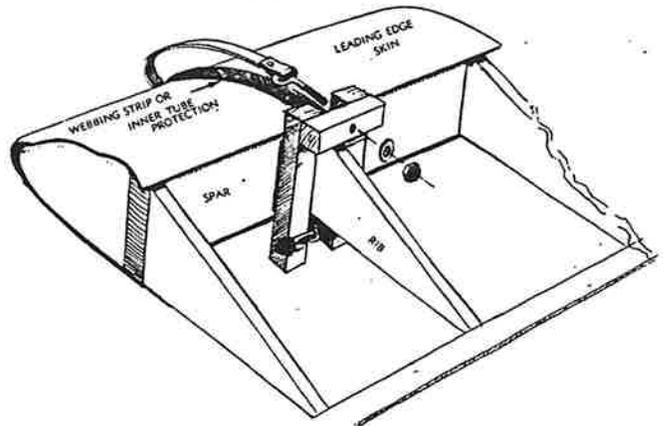
The simple clamp illustrated is easy to make from odds and ends found around the average shop and requires no welding. Its design permits clamping pressure where it is most needed . . . directly over the rib. The clamp is especially valuable if the structure's nose ribs are of thin plywood stock and nail-strip clamping is out of the question. The dimensions are not critical and the device is self adjusting to various spar depths.

For my flaps I made a separate clamp to fit over each rib. The plywood skin was first pre-formed and prepared for gluing. I then cut 1 inch wide rubber loops from an old inner tube and slipped one over each rib and completely around the flap frame. This later pro-



LEADING EDGE CLAMP

LEADING EDGE CLAMP POSITIONED



vided a cushion under the metal straps and the use of protective webbing as shown in the sketch was not necessary. The inner tube loops also contributed a partial clamping effect and held the skin in place while the clamps were placed and carefully tightened.

NOTE: Be sure your structure is free from warpage and is properly aligned prior to final gluing and clamping of the leading edge.

Notice that the bolt or rod is slipped through the bottom loop of the metal band and is held in place under the rib and behind the "U" frame by tension exerted through the strap when the eyebolt's nut is tightened.

The spacer of plywood holds the clamp frame away from the spar to insure that there is no interference with the untrimmed edge of the plywood cover being glued.

This same gadget can also be used to hold a balky metal leading edge cover in exact position for nailing.

THIS IS REALLY FLYING . . .

(Continued from preceding page)

spend about one hour en route to Rockford Fly-In. Another perfect picture awaited my arrival. I found Rockford airport to be one of the most beautiful, green grass turf and concrete runway layouts I had ever seen. Airplanes all over the sky and parked on the display ramps gave me the feeling that there were many others who had shared my same feelings for their own ships.

The Fly-In itself was grand — I had to limit myself on the time I could spend at any one function or display because it was obvious that I couldn't take it all in, with only three days left. I made the acquaintance of several owner/builders I had seen in the magazines, talked to the "pros" about their particular endeavors, and took great pride in showing off my own airplane. I had also armed myself with a new movie camera and a dozen rolls of color film. I'm very happy to say that all pictures came out perfect and have been kept busy showing them to the local clubs in southern California area.

The time for departure came all too soon — left Rockford about noon and after dodging a line of thunderstorms for about 400 miles, I arrived in Wichita, Kans., where I spent the night. Had to have one of the exhaust gaskets replaced here—the first bit of mechanical

difficulty during the entire trip. Phoned Dean Case and spent quite a spell talking to him about airplanes and made arrangements to meet him in the morning when we would look at his new Pitt's Special he had just started. We got off to a late start again because of the interesting conversations that just seem to get started whenever airplane men get together.

Fair weather, good tail winds, and omni radio navigation made the rest of the trip uneventful except for the same interest in the countryside as we flew over it. On the last few miles of the trip, just after leaving Thermal, I lost my right side exhaust stack. Evidently the weld had crystallized and had fallen off. I imagined all sorts of things—fire—fuel tank exploding from the raw heat just ahead of the firewall, etc. In fact, I had the shoulder harness off and the seat belt was loose just in case I had to go over the side! And this was within five miles of where I had lost my Mooney a few months ago. Needless to say, "Starduster" got me back on terra firma at my home base in San Diego in due time, but I was a little regretful that our "honeymoon" was over. She now has a new exhaust stack and is ready to go again. Think I'll run out to the field now for a short practice hop. See you at this year's Fly-In.

Cockpit Design Simplified

By Michael C. Myal, EAA 7978
28763 Cunningham, Warren, Mich.

THERE IS an apparent need for a simple solution to the problem of cockpit layout. Other methods are presented elsewhere which unnecessarily complicate the procedure. A design technique, pioneered by General Motors and developed through the SAE (SAE Standard J 826), is used throughout the automobile industry. It is simple, realistic, and positive.

Structural design of the aircraft should begin only when the cockpit area is dimensionally fixed and its comfort variables related to the intended purpose of this design. This simplified cockpit design technique should be an encouragement to the homebuilt aircraft designer to begin his project with confidence, and will prove to be a time-saving asset to the manufacturer of aircraft.

THE MAN. Human factors specialists agree that man's needs be completely analyzed before attempting the design of any vehicle. These highly skilled people seek to provide the vehicle operator with degrees of roominess, comfort, visibility, and safety consistent with the function of the vehicle or structure. They always begin with the human and his requirements, capabilities, or limitations. Our simplified technique follows this principle; ample cockpit space is guaranteed.

By employing a scale 2 D MANIKIN of a large size, as shown in Fig. 1, people of lesser stature will be fully

accommodated. The standard size of this manikin has been selected with extreme care. He is 90 percentile in all body segments, which means 90 percent of the American males are shorter for each body segment. Studies have conclusively proved man is not perfectly proportioned; he may have short legs and a long torso or vice versa. Thus, this manikin actually determines the space requirements of better than 95 percent of the American males, since all of its body segments are at the 90 percentile level.

The question might now be raised, "Why not use a 95 percentile manikin?" Economics of structure weight encourage the use of the 90 percentile size; the cockpit should never be primarily designed for the extremely large person. Persons over the 95 percentile level will possibly be sitting in a "jack-knifed" position. The problem here is no different than that daily faced by that size of man. Doorways, clothing, even tying a shoelace, are generally overcome—if not gracefully. For the sake of improved aircraft PERFORMANCE space must be considered a premium, not to be lavishly used.

ATTITUDE COMFORT. We agree that the 90 percentile manikin will provide adequate space, but the problem now arises as to man's comfort requirements.

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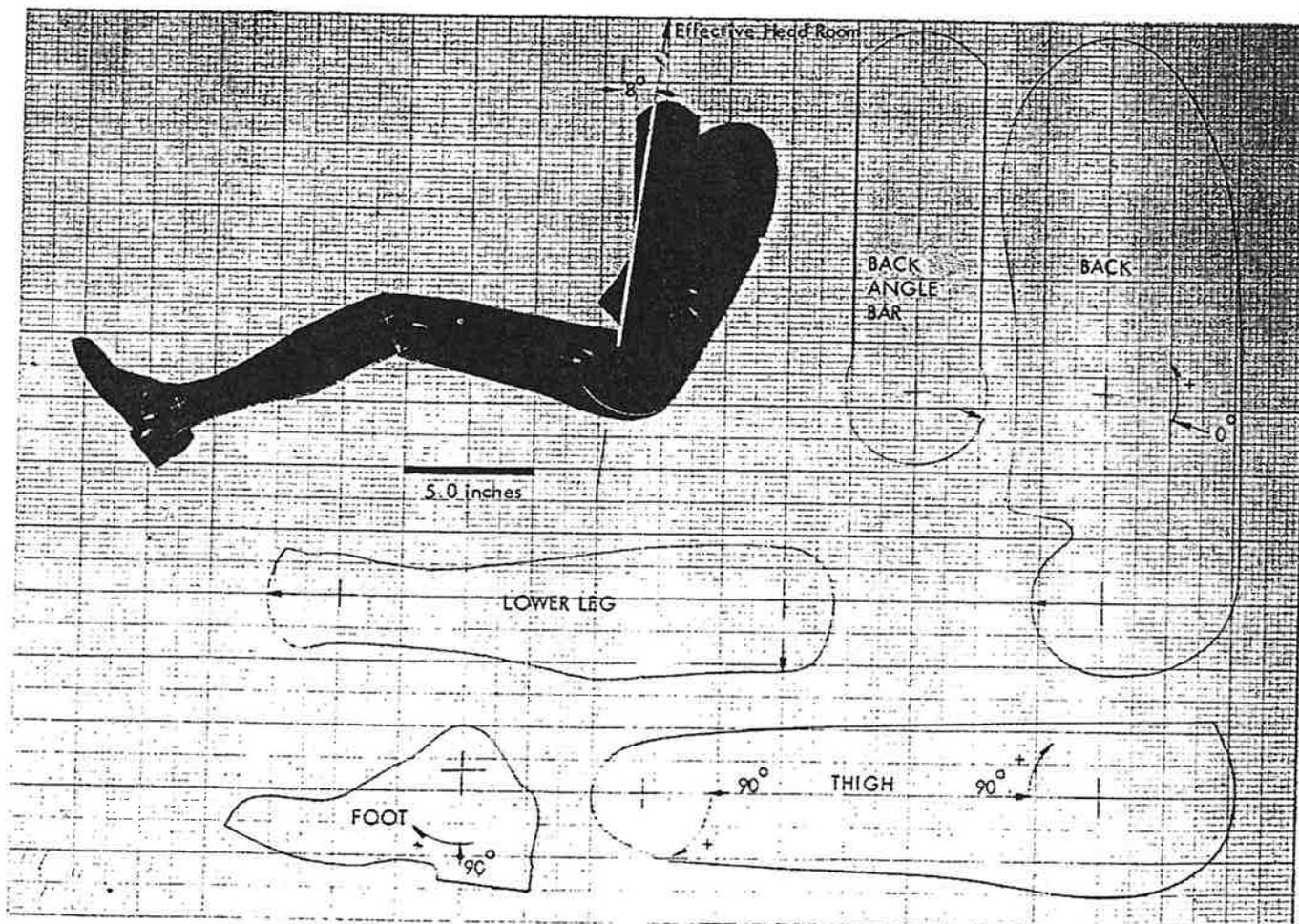


Fig. 1 Scale layout of the SAE 2 D manikin with degree scale orientation and insert of assembled manikin. The + sign indicates angle increase.

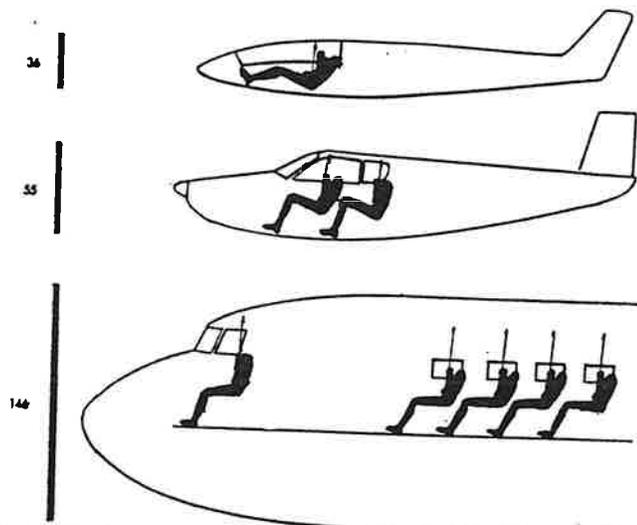


Fig. 2 Some seating possibilities of the 2 D manikin. Space is allotted by controlling human comfort angles. Very difficult to compare using linear measurements.

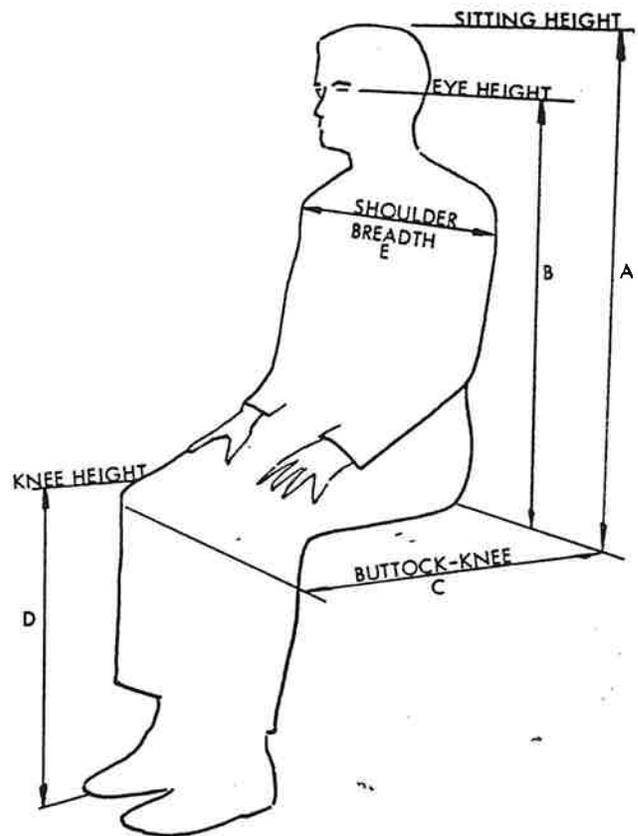
COCKPIT DESIGN SIMPLIFIED . . .

(Continued from preceding page)

There are two comfort factors: Attitude comfort is that **PHYSIOLOGICAL** reaction of the body to position or posture, while seat comfort is usually considered as that degree of support given the seated body. People tend to recognize the latter and mistakably judge the overall comfort of the compartment by the softness of the seat cushions. Seated attitude is a far more serious aspect of comfort, since little can be done to improve it once the aircraft is built without resorting to costly re-work.

Let us first consider attitude comfort. The human anatomy (also the 2 D manikin) can be literally doubled up into a "squatting" position so that it occupies only 25 inches of horizontal space in the airplane. Although not at all practical, this comparison brings out several significant features of the human anatomy. First, the body is highly adaptable to many posture attitudes and many of its segments have considerable freedom of movement. Second, the body segments are highly sensitive to angular displacement. We will use these elements to correctly design our cockpit with the 2 D manikin.

COCKPIT ROOMINESS. The actual size of the cockpit area can now be easily defined by the 2 D manikin and its **COMFORT ANGLES**. These four angles, the foot, knee, hip, and the back angle are representative of human body segment angular ranges as determined by detailed researches of the subject. We can, by manipulating the angles on the 2 D manikin, individually or in combination, depict a realistic cockpit configuration for any type of aircraft which will provide full room and comfort for over 95 percent of American males, (Fig. 2). To complete our side view, the height over the occupant's head is established. Called **EFFECTIVE HEADROOM** in the automobile industry, this standard dimension is measured on a reclining 8 degree line from the "H" POINT, the hip joint center of the 2 D manikin for conventional back angles. The 8 degree line has been determined as being the average position of the head for conventional seat back angles, which due to postural differences in people, can vary from approximately -2.0 degrees to +12.0 degrees. In order to maintain a consistency with human seated height measurements, this dimension is measured from the "H" point to the roof or headliner, and a constant 4.0 inches is added to this figure to compensate for the distance to the bottom of the buttocks.



%	A	B	C	D	E
95	38.1	33.2	25.4	24.2	19.1
90	37.6	32.7	24.9	23.9	18.8
80	37.1	32.1	24.4	23.5	18.5
70	36.6	31.7	24.1	23.2	18.2
60	36.3	31.3	23.7	22.9	18.1
50	36.0	31.0	23.4	22.7	17.9
40	35.6	30.7	23.1	22.4	17.7
30	34.3	30.3	22.8	22.2	17.5
20	34.9	29.9	22.4	21.9	17.2
10	34.3	29.3	21.9	21.4	16.9
5	33.8	28.8	21.5	21.1	16.6

PERCENTILE TABLE VERSUS HUMAN DIMENSIONS

Fig. 3 Human comfort variabilities. A quick check of these variables will determine your percentile size relative to adult American male statistics and will aid your evaluation of your prototype.

The width of the cockpit must be considered from the standpoint of roominess. The prime dimension indicated comfort is **SHOULDER ROOM**, the distance between opposing longerons or the trimmed side walls at the "belt" or lower window opening. This dimension is closely related to human shoulder width shown in Fig. 3. A shoulder room dimension of 40 inches is needed to accommodate two 95 percentile men in the side-by-side configuration, allowing .8 of an inch for light clothing.

Perhaps only one 90 percentile and one 50 percentile male will occupy the airplane at a given time, which reduces the shoulder room requirement to 37.5 inches. The PSYCHOLOGICAL factor here will largely establish cockpit width; presumably, the lesser dimension might be acceptable to the occupants of a fast, short-range ship while the dimensions over 40 inches would possibly be necessary for slower longer-range aircraft. In any case, the 40 inch dimension (or 20 inches for the single-place aircraft) should serve as a point of departure, comparing this figure to existing aircraft cockpit widths to determine the final dimension of shoulder room.

To define our cockpit roominess, only six facts are required: the four comfort angles, effective headroom, and shoulder room. Study of aircraft and automobile dimensioning practices, as found in Fig. 4, before attempting the initial layout will prove beneficial to the designer.

LAYOUT AND PERFORMANCE. We have established a guide for determining the proper shoulder room and have briefly mentioned the psychological aspect of this dimension. Just as we balance the aircraft performance factors of speed, range, and maneuverability to fit the intended purposes of the airplane, so, also, we must consider the size and comfort of the passenger compartment in terms of over-all intent of the airplane. It is economically desirable to provide the pilot and passenger with the MINIMUM SPACE consistent with the task assigned the aircraft.

Aircraft profile drag is a function of frontal area; less frontal area results in less drag for the same shape of fuselage. The tandem arrangement which offers minimum frontal area, is not completely successful in this respect because of present engine configurations. Cockpit frontal area can be said to be the product of the chosen shoulder room and fuselage depth at the cockpit section. The aircraft side views in Fig. 2 best describe fuselage depth. By reducing effective headroom, we immediately lower the top fuselage line and decrease the frontal area. We can also reduce the frontal area by raising the heel of the manikin. These reductions in fuselage depth affect the comfort of the occupants. To what extent this process can be carried out should be of prime concern to the designer.

To begin our design, we should first construct the 2 D manikin scaled to the drawing size; Fig. 1 contains the necessary information for making an accurate cardboard, plywood, or plastic tool. Degree quadrants should be incorporated for each of the body segments. On a clean piece of vellum, horizontal and vertical lines are established. The intersection of the two is used to locate the "H" point. Next, by drawing an 8 degree line from this point, just as in a heading in map plotting, the effective headroom line is established. The average di-

mension of 90 percentile male erect sitting heights (buttock to top of head) is 37.6 inches, while the 95 percentile figure is 38.1 inches from Fig. 3. Normal body posture will reduce this by approximately 1 inch. Since we should accommodate 95 percentile of the males, the dimension we could use is 37.1 inches of effective headroom. However, intimate contact of head and canopy or head lining is not acceptable, so we could increase this figure to 37.6 inches. Scaling this dimension onto our layout and marking off an additional one-half inch for a canopy or headlining thickness will establish the top fuselage line and the necessary headroom.

Next step is to design the attitude comfort of our aircraft. Refer to Fig. 4. The back angle can normally vary from 20 degrees to 35 degrees. According to the N.A.A. rules for 190 cubic inch displacement racing airplanes, the back angle cannot exceed 20 degrees; we can assume that stiffer back angles are required in alert situations. On the other hand, the reclining back angles of over 45 degrees, which are used on the "Foka" and "Zefir," Polish sailplanes, indicate a lesser alert requirement. It is recommended that a 24 degree back angle be used whenever possible, which provides an attitude with relaxed, but firm, support compared to the best of today's automobiles. Only for crop dusting, racing, or similar alert situations would lesser angles be necessary. Higher back angles, over 24 degrees, are advantageous for the passenger, in that they place more of the torso weight onto the seat back also increasing the hip area comfort.

The hip angle is the major comfort angle in the packaging of the cockpit. A comfort relationship between the abdomen and the thighs, the large hip angle generally provides more comfort. However, an extreme angle over 105 degrees will usually place the body in an awkward unbalanced position. A hip angle of 95.0 degrees, plus or minus 2.0 degrees, is recommended as a preliminary design starting point. In the rear compartment, varying hip angles ranging as low as 80 degrees can be utilized to develop occasional seating.

The knee angle has a high latitude of angular movement. Any angle between 80 degrees and 140 degrees can be considered satisfactory for our design. Angles over 140 degrees should be viewed carefully to insure that the under thigh tendons at the knee junction are not subjected to excessive seat pressures. The foot angle, which is measured at the barefoot-lower leg intersection, should be held at 90 degrees to establish the zero rudder position. The ranges of angular movement are 80 degrees to 120 degrees. Rudder pedal travel should be such that under a full turn condition the manikin foot angle does not exceed 115 degrees, preferably 110 degrees, when the heel point position of zero rudder is held.

Assuming that we have chosen 24 degrees, 95 degrees, 120 degrees, and 90 degrees for the back, hip, knee, (Continued on next page)

	Frontal Area	Fuselage Depth	Effective Headroom	Shoulder Room	Back Angle	Hip Angle	Knee Angle	Foot Angle	Knee Clearance	Torso to Panel	Torso to Wheel
Piper Colt	12.2	44.1	38.4	40.0	25.0°	95.0°	122.0°	89.0°	7.7	21.9	15.5
Piper Cherokee	13.2	46.5	39.0	41.0	27.5°	98.5°	118.5°	106.5°	7.3	22.1	15.0
Cessna 140	11.5	44.5	39.3	37.3	20.5°	91.0°	122.5°	74.0°	6.5	23.6	14.5
Beech Bonanza	14.2	47.4	39.3	43.0	22.5°	87.0°	97.5°	62.0°	4.5	19.8	9.5
1963 Corvette Fastback			37.0	48.2	24.5°	96.0°	127.0°	72.0°			
1963 Corvair Monza Coupe			37.8	53.9	22.0°	90.5°	124.5°	81.0°			
1963 Buick Riviera			37.6	56.3	27.0°	93.0°	116.0°	84.0°			
1963 Cadillac Sixty Special			40.0	58.7	23.0°	91.0°	120.0°	82.0°			

Fig. 4

Fig. 4 Aircraft and automobile dimensions, taken to accelerator or rudder pedals. A check of these vehicles and

their comfort will be helpful in establishing your initial layout. (Seats in rearmost position).

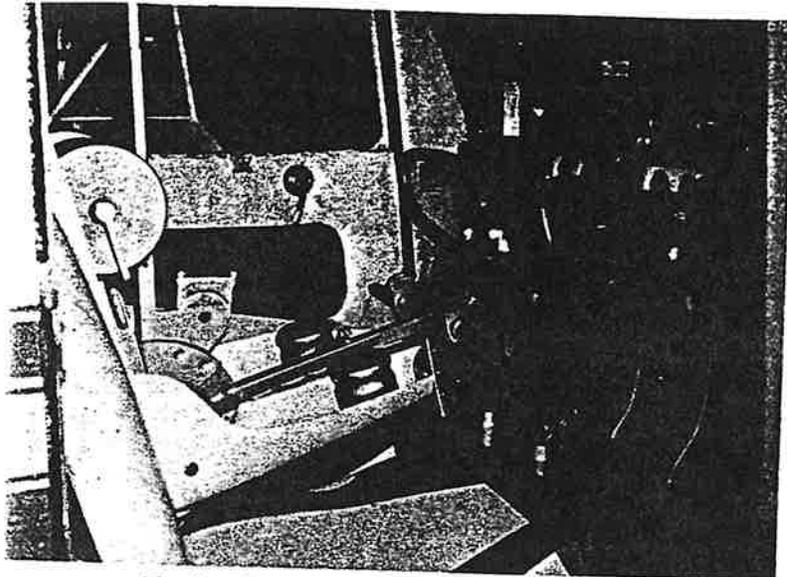


Fig. 5 Photograph of the SAE 3 D manikin. Used by automobile manufacturers to check prototypes and for quality control of production vehicles. Here installed in Cessna 140.

COCKPIT DESIGN SIMPLIFIED . . .

(Continued from preceding page)

and foot angles, respectively, we set these angles on our manikin which is then placed on the vellum with the "H" point superimposed over the intersection point. The manikin is rotated about the "H" point until the back bar is parallel to vertical and the back contour is at 24 degrees. The manikin is outlined on the vellum in this position.

A half inch of floor thickness is scaled on the drawing below the heel establishing the bottom of the fuselage. A full scale check of this layout indicates a design fuselage depth of 44.7 inches and a frontal area of 12.4 square feet as compared to the production aircraft in Fig. 4. If we increase the knee angle from 120 degrees to 130 degrees by raising the heel, fuselage depth becomes 41.7 inches, a reduction of 3.0 inches in fuselage depth or a reduction of 120 square inches, almost .9 of a square foot of frontal area! The function of human comfort angles in packaging becomes more apparent with use. Any change from known cockpit roominess is reported in terms of changes in human attitude comfort. Linear dimensions expressing the roominess of a cockpit, on the other hand, never reflect the true comfort conditions.

These typical comfort angles illustrate the simplicity of this procedure to lay out a cockpit. It is hoped that this example will stimulate the creativity of the reader to seek an INDIVIDUAL solution to his PARTICULAR application.

The completed cockpit layout vellum can be used as an overlay to check the finished three-view drawing for structural clearances or can be the beginning of a fresh three-view design.

PROVING THE LAYOUT. An indispensable tool for the designer is a seating mockup, Fig. 5. Primarily built to check out the seating developed during the layout phase, it is valuable also as a temporary fixture. As the

BIBLIOGRAPHY

(covers important facets of dimensioning developments)
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construction phase develops, the platform can be used to build up the canopy installation, controls, the instrument panel, etc., without reference to bulky fuselage. A 4 ft. by 8 ft. sheet of $\frac{3}{4}$ inch builder's fir plywood attached to 2 by 4 sub frame should prove to be sufficient to support cockpit components for a four-place cockpit.

Initially, the seating positions should be checked out. Since the manikin establishes the depressed human contour, it is necessary before designing the seat frame and location to determine the depressed padding thickness by the "ouch" test.

Using a sample of the intended padding material, place the pad over a plastic web lawn chair. Sit on same and have someone check the depressed depth of the pad carefully with a needle! This dimension is then added to the manikin depressed line and establishes the side view line of the seat frame. The same technique can be adapted to the approximation of the depressed manikin line for an existing seat using the assistance of a friend about 69 inches tall and weighing about 170 pounds sitting in the seat.

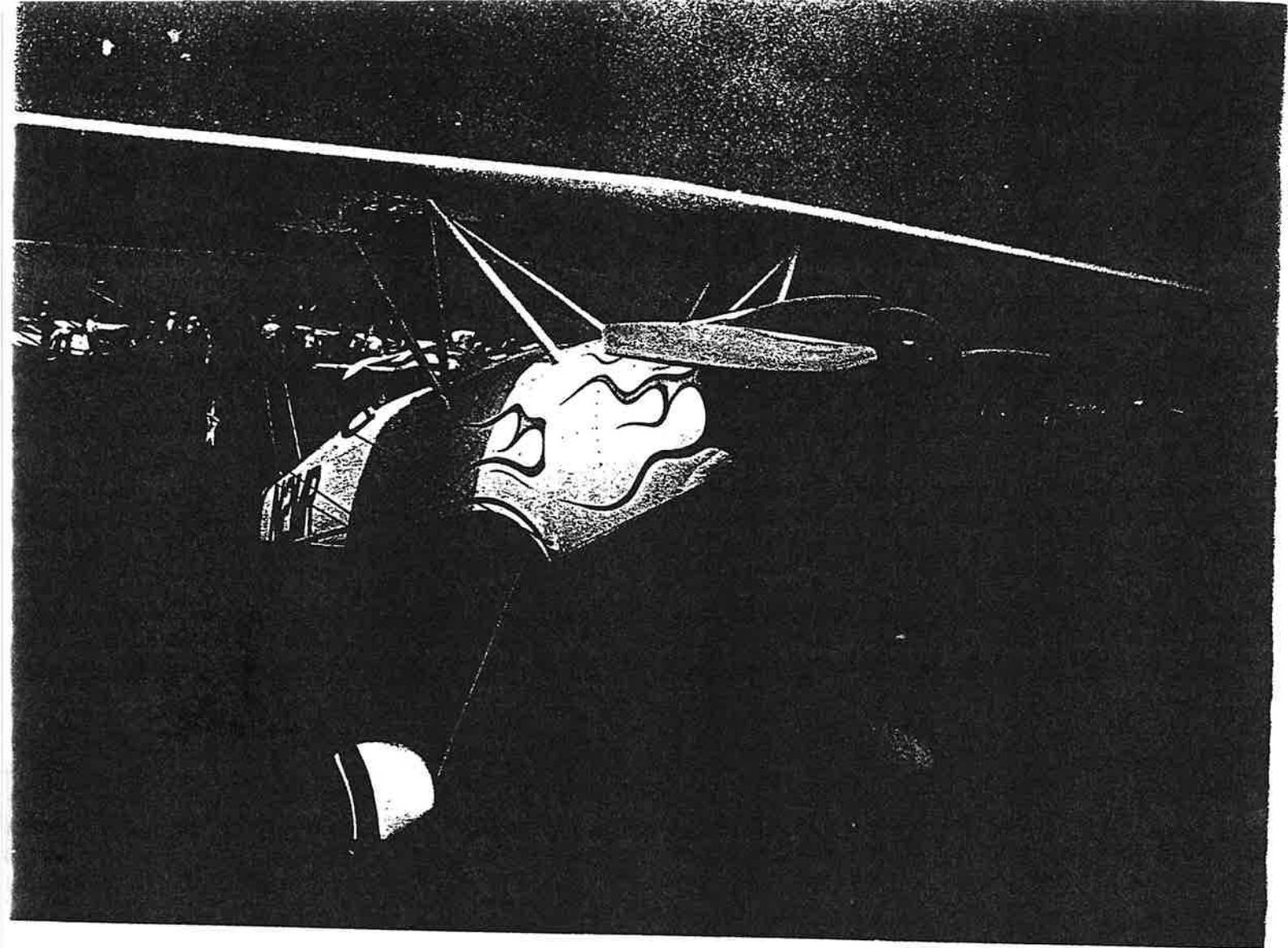
Having determined the rearmost location of the seat structure, the construction phase can be concluded by the addition of the foot controls per the vellum layout. If you are about 70 inches in height or shorter you should find an excess amount of leg space in your design. Have a friend over 70 inches in height try it for size; he should find the size of the compartment to be adequate.

SUMMARY. We have covered most briefly the arguments for using the manikin and the comfort dimensioning method in developing aircraft seating. If you are of the one percent of the population that matches the scale manikin, feel perfectly free to design your aircraft by the cut and try method. However, you can save valuable design time by following this simple procedure and you are further guaranteed that any potential buyer will find sufficient roominess in your ship. It should be remembered that linear dimensions from production aircraft can frequently be misleading and, of course, do not tell the entire comfort story. A few pointers to save weight, the seat structure should be designed as part of the wing as in the Beech Bonanza, or fuselage as on the Cessna 140. Foam rubber is the best available pad material; a cored, easily compressed pad rates best for comfort than the denser variations, although it is not as durable. Seat springs are not necessary for aircraft application; a web backing is sufficient. Cloth is more comfortable than vinyl; some military researchers recommend 4 inches of cored foam rubber covered with "Helanca," a stretch ski pant fabric which has high performance and is porous. Seat depth should not exceed 18 inches for comfort, (from the manikin back contour forward). The nose of the seat should not be squared off.

The seat structure should be fixed for safety and weight reasons; foot controls should be designed fully adjustable and have at least 5 inches of travel towards the seat from the design location. Individual vertical seat adjustment, up to 4 inches if you wish to consider the ladies, can be easily accomplished by providing for blocking up the seat cushion pad with styrofoam or other low weight materials.

The CG of the manikin is at the intersection of a line parallel and 10 inches forward of the back and a line 5 inches above and parallel to the thigh centerline (knee and hip point line) for most sitting attitudes.

Technical inquiries concerning the manikin tools and their availability should be directed to the SAE, 485 Lexington Ave., New York 17, N.Y.



(Photo by Dick Stouffer)

ROGER ROURKE CAME to Oshkosh '77 to win the Grand Champion award with his magnificent Starduster Too . . . and when he left, he had the prize stowed securely away in his baggage compartment.

He had made no bones about his intentions . . . his calculated reach for the brass ring went according to plan.

Items:

* He and his wife Marilyn left their Culver City, California home early to allow for bad weather enroute to Wisconsin . . .

* One of the first arrivals at Oshkosh, Roger was quick to choose a choice tie-down spot next to the fence, so the general public could get a close look at the airplane . . .

* Using fancy little plastic rods, he proceeded to stake out a small compound within which the Starduster could be roped off, both for protection and better viewing by expected crowds. The ropes were placed in such a way that spectators could look into the rear cockpit from either side of the fuselage . . .

* The plane was then thoroughly cleaned and waxed . . . after which Roger steadfastly refused to move it an inch until he, later in the week, was absolutely certain the judges had made their final appraisal of its virtues . . .

* A stack of printed spec sheets was placed out each day for spectators — and judges — to pick up . . .

* Roger stayed with his Starduster all week, answer-

ing questions, demonstrating the tape system, opening the cowling, etc., etc., until he was so hoarse he had to start sucking on throat lozenges to keep going . . .

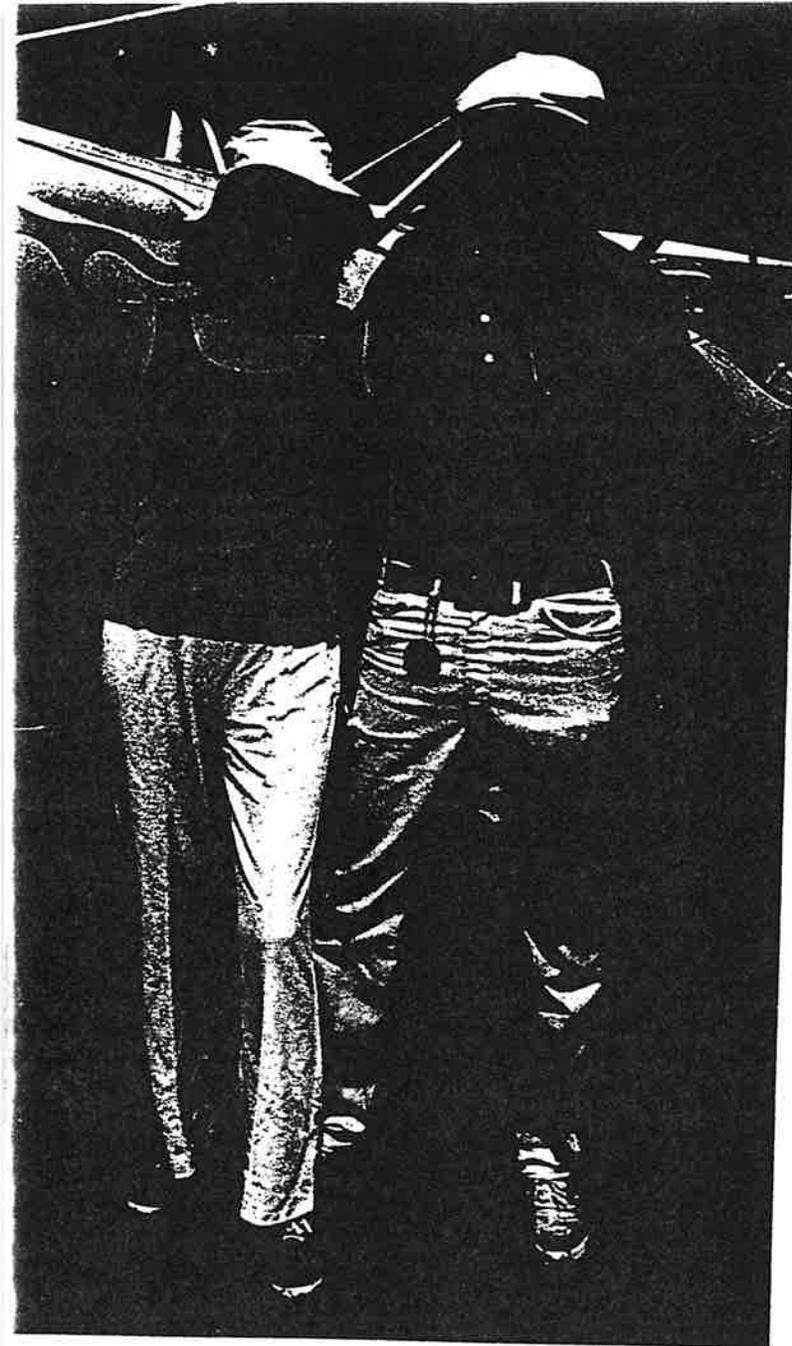
* Picking out his likely rivals, Roger sweated bullets all week as the judges made their rounds, particularly in the last stages when they passed right by his airplane to inspect the others. (They were trying to decide on the Honorable Mentions . . . but Roger didn't know that.) . . .

Finally, on Friday night when N2MR was named the Grand Champion, the happiest kid in the place went bounding down the aisle, leaped up the stairs to the stage and jubilantly hoisted his Lindy trophy on high. He called his wife to the stage to share his moments of euphoria and didn't mind a bit when the photographers asked for that inevitable "just one more".

It would be strange, indeed, for the recipient of the EAA's annual Grand Champion Custom Built award **not** to be happy about it . . . but there may have been one or two in the audience who thought that perhaps Roger was overdoing it just a tiny bit.

But, then, they didn't know . . .

They didn't know that 3 years, 1 month, 20 days and a few hours back in time, this same happy fella was on the beach at Santa Monica . . . hanging upside down in the harness of this same Starduster, with blood spurting out of a nasty cut across his eyebrow. On top of him was a crumpled airplane with an engine that had utterly destroyed itself after swallowing one of Lycoming's infamous 7 16 exhaust valves.



(Photo by Jack Cox)
Roger Rourke and his wife, Marilyn.

Six years of his life, several thousand hours of labor and many bucks down the tube . . . and we call him a "happy fella"? Not that day.

Obviously, Roger Rourke picked himself and his Starduster up that June day and put all the pieces back together again. It is further obvious that the second time around he went after making the airplane a true show-piece with a vengeance. You bet your life Roger came to Oshkosh '77 to win — by that time he had nine years of his life in the airplane. 8,000 hours of labor — 2,000 in sanding alone! — and mucho, mucho dinero sunk in the bird.

All this, of course, has simply been an attempt to show the human side of a Grand Champion — it meant nothing to a beady-eyed judge dilligently searching for a telltale run in the paint or an offending bolt without the proper number of threads showing past the nut. No, in the end, the Starduster had to stand on its own merits as a safely and beautifully constructed airplane.

The competition this year was brutal — the final five or six aircraft John Beetham and his footsore crew of judges eventually worked their way around to were each so good that the selection process that determined the eventual order of finish necessarily involved nit-picking of the highest order. Any of the Honorable Mentions selected this year would have been sure-fire Grand Champions just a few years ago. But such is growth and development of the homebuilt movement . . . next year it will be even tougher!

THE AIRPLANE

O.K., so much for the preliminaries — what about the machine itself? What caused the judges to select Starduster Too N2MR (for Marilyn and Roger) as the best in the land for 1977?

Roger bought his plans in 1965 — or rather a contract for plans. Lou Stolp was designing and building a prototype simultaneously and builders received the next sheet as soon as it came off the drawing board. Roger built the airplane completely — welding, woodwork, painting, etc. — in his garage over a period of six years. This included taking the better part of three years off to start his own business, Rourke Engineering, a machine shop operation.

The original engine was a Lycoming O-360 A1A, turning a McCauley CS propeller. The package was from a Mooney that had hit a cow down in Mexico. It had between 400 and 500 hours when purchased, but Roger went through it completely and brought everything back to factory new specs . . . except for substituting ½" valves for the 7/16" originals. He did not know about this change at that time.

The airframe was built pretty much to the Stolp plans and was finished in the same fire licked yellow paint scheme we saw this year at Oshkosh.

After about 100 hours of use, a Christen inverted oil system, a pressure carb and a smoke system were installed — and Roger went out to teach himself aerobatics. Trial and error proved exciting, even if not too instructive. He once spun out of a too-tight turn — at full throttle — and saw 220 mph before affecting a pull-out. 9 Gs (positive) were rung up on the G-meter when he landed so he figured the airframe had been adequately load tested. Some aerobatic instruction was ordered up immediately to make sure the pilot was up to the airplane.

This, unfortunately, didn't help with the Lycoming. At 259.5 hours since a complete major, the big four-banger self-destructed. Roger recalls . . .

"It was Saturday, June 15, 1974. I'd been out over the Pacific practicing an aerobatic routine to fly in Sportsman competition and was heading back towards Santa Monica. Just as I crossed the shoreline — at 1600 feet — the engine started running erratically. I looked down at the gauges and saw the oil pressure rapidly dropping to zero and the tach following it down. Before I could even look back up, the prop had stopped — in a horizontal mode. I hit the starter . . . absolutely nothing, so I knew the engine was out for keeps. The only thing to do then was look for a place to park it.

"I saw a little stretch of beach that didn't have anyone on it — 30 or 40 feet wide, maybe 200 feet long and running right down to water's edge. So, I tried to time my rate of descent to come in from the ocean side, right at the edge of the water and see if I could stop it right there.

"I had planned on making one revolution and landing on the second one, but never having tried to glide with the prop stopped, I was surprised at how much less drag there was (than with the engine at idle).

"Of course, in the meantime I'd already called Santa Monica tower and told them the engine was out and I

was going to park it on the beach. They said there was a patrol Cessna in the area they would try to get to come in with a siren to alert the bathers . . . which they did. They caught up to me on the second pass and followed me down with the siren going.

"On my second pass over the beach I was still higher than I ever dreamed I would be . . . in fact, with another 200 to 300 feet I probably could have made it all the way inland to Santa Monica airport. But . . . hindsight! Anyway, on the third pass, I had to go quite a ways out to sea — I'd say as much as a quarter of a mile — so that I could touch it down right at the water's edge. Heading in, I kept bleeding off the airspeed more and more . . . and when I passed over the edge of the beach, just inches off, I hauled back on the stick and it just fell flat right onto the sand. It hit once and bounced upside down. Used a grand total of 18 feet of beach."

Unhurt, except for the cut over an eye, Roger scrambled out from under the Too and standing there with the Pacific lapping up within a few feet of the prop, began the long and tortuous road to Oshkosh '77.

After getting the wreckage back home in his garage

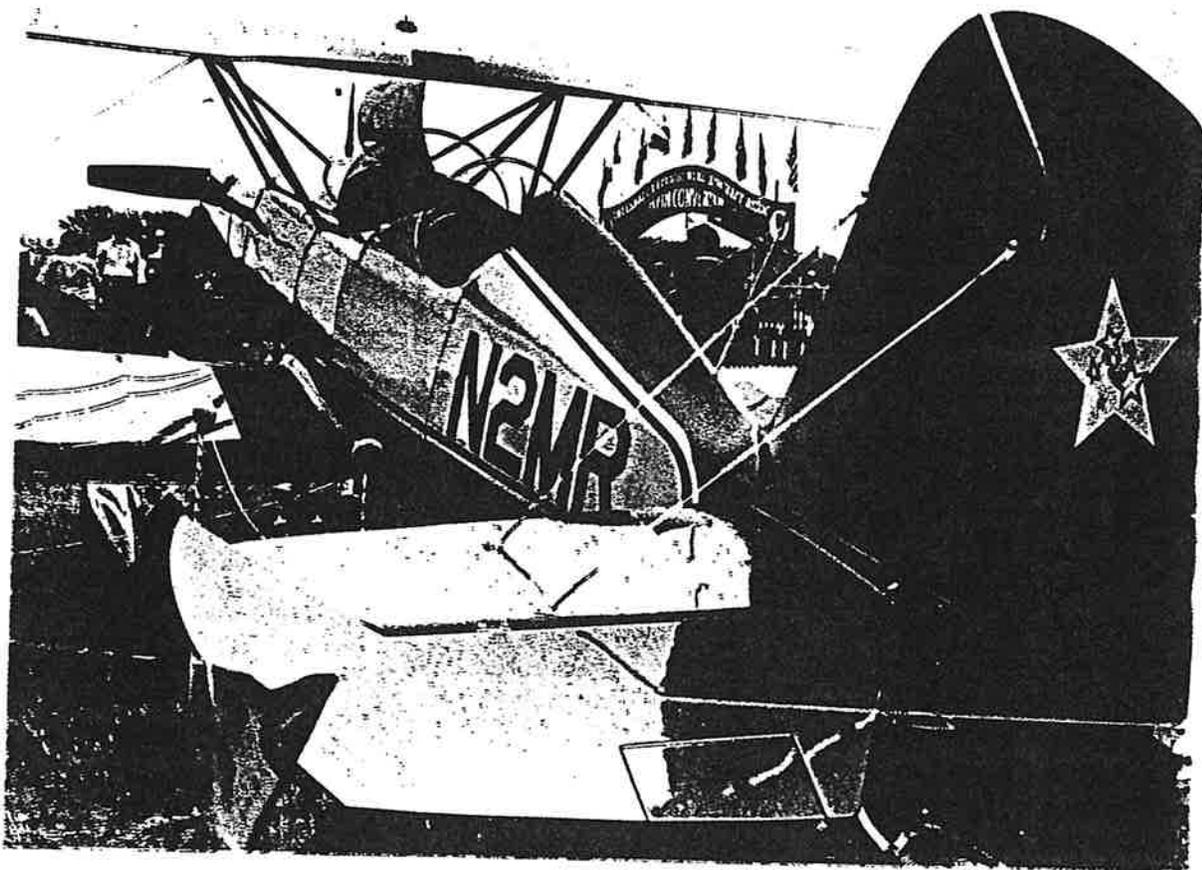
that" refrains became. In the end, the decision was made in favor of the "I wish I had's". N2MR would be reincarnated as a super ship, a bounty hunter with which to head back east and capture some of that Oshkosh booty.

The first order of business was to replace the engine. Already in his shop was a Lycoming HIO-360-A1A from a Hughes helicopter. Since it was the same physical size but with more power (200), it became the logical choice. It was given a complete major, doubly balanced, all ADS were complied with . . . and Roger assured himself it had ½" valves!!

In addition, the exterior of the engine was given the full cosmetic treatment. Everything was cleaned up, repainted, chromed, or plated or had had some kind of finishing done to reduce corrosion. The exhaust system is stainless, all the intake tubes were chrome plated or buffed and all the control rods were plated. Even the firewall is polished stainless steel.

The battery venting system (for inverted flight) is made of Lexan and is a triple acid trap that can never leak a drop.

Since a new landing gear had to be made anyway,



(Photo by Ted Koston)

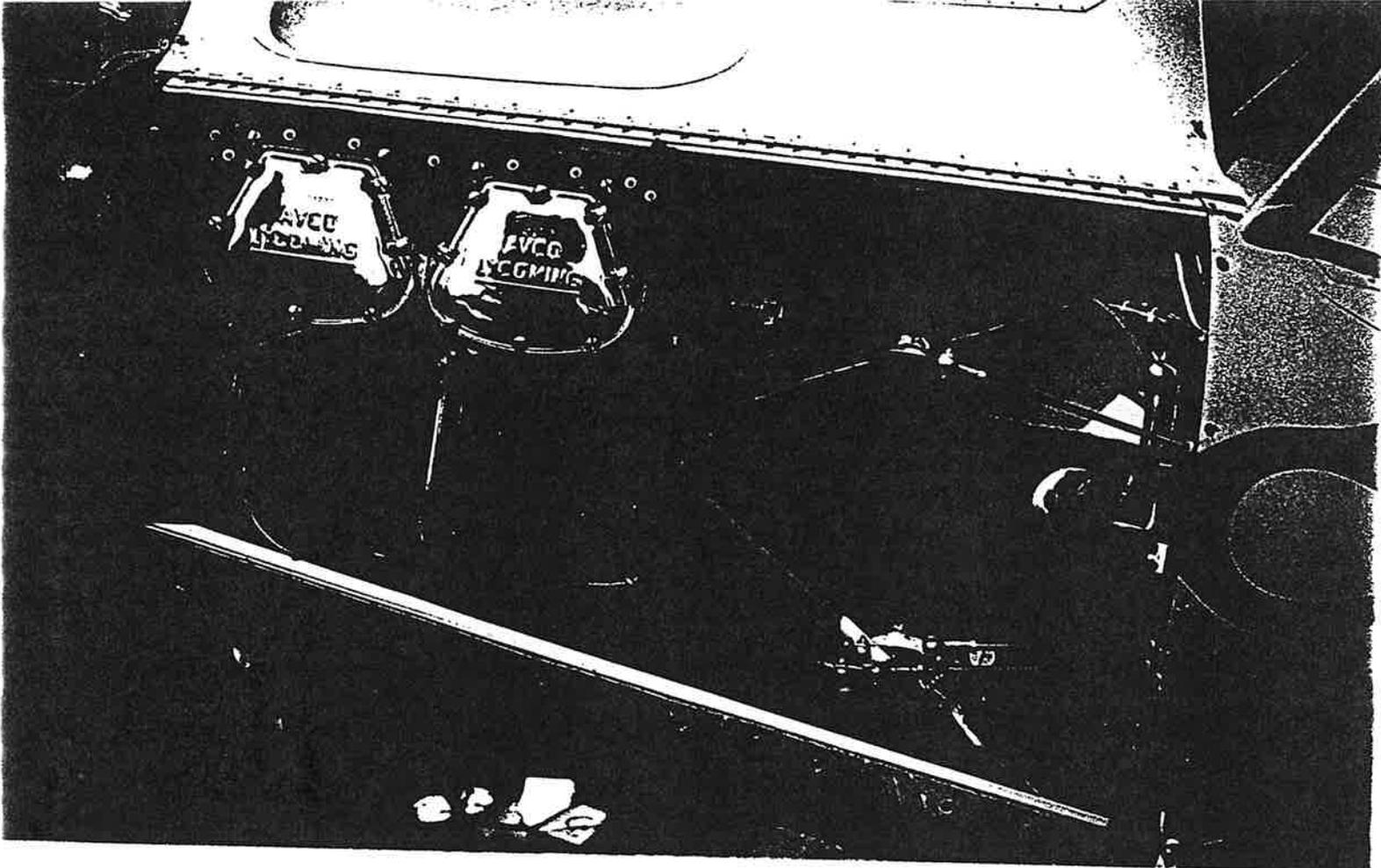
Even a Grand Champion gets rained on once in a while. That's the Rourke logo on the rudder that caused the surface to be reworked nine times before it met Roger's standards.

workshop, Roger surveyed the damage and found it not to be as extensive as he had feared. There was fuselage damage — some tubes would have to be replaced; the landing gear and rudder were smashed beyond economical repair but, luckily, the wings weren't bad at all. A few cracked ribs were found, but the spars came through unscathed. The engine, however, was a mess. The head had popped off an exhaust valve, which, in turn, cracked the piston in half . . . which broke the other 3 pistons . . . the cam . . . split the crank case in half. Junk city!

After a really close look, Roger estimated he could have the plane flying again in about a year. But the more he thought about it, the more pervasive those "Gee, I wish I had done this . . . and if I had it to do again, I'd do

Roger decided to correct one of the faults of the early Starduster Toos — too much weight on the tailwheel as a result of the main wheels being too far forward. His new gear, therefore, placed the wheel centers 5½" aft of their original position, taking almost 80 pounds off the tailwheel. Best of all, ground handling characteristics were dramatically improved.

Anyone who has ever wiggled the stick of N2MR is impressed with the silky smoothness. Roger says this is one of several areas in the aircraft that benefitted from



(Photo by Jack Cox)
Left side of Roger Rourke's extremely sanitary engine compartment. Plating and glitter galore!

his ownership of a machine shop. Everything in the control system is on bearings of the appropriate type. Further, even the bearings, themselves, have been given the Rourke treatment — ball bushings carefully honed and lapped to achieve minimal tolerance and maximum "freeness".

A number of new processes were given a try during the rebuild — two of which were eminently unsuccessful. Most notorious in Roger's mind today was his 6 month struggle to fabricate foam/Dynel/epoxy wing leading edges. First time around all went reasonably well, resulting in beautifully smooth leading edges for all four panels. Then one hot day Roger noticed what appeared to be some expansion on a wing that had been left out in the sun. Concerned, he grabbed a heat lamp and a thermometer and proceeded to bring an area of the leading edge up to a surface temperature of 200° F. A tremendous bulge was the sickening result.

The next week was spent building a heat box that could hold an entire leading edge. A dozen heat lamps, several thermometers and fans to circulate the heat were used to bring the full leading edge up into the 200° range — which saw some areas puff out as much as . . . oh, woe! . . . a full inch. Nothing to do but rip it all out and start over again.

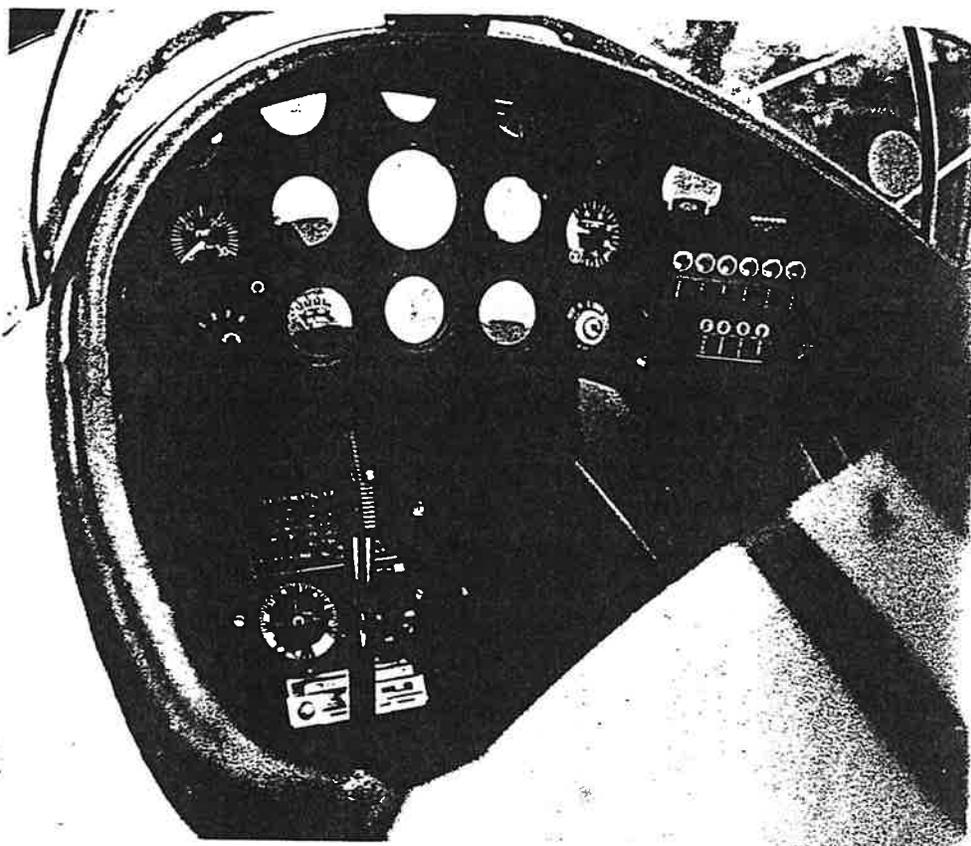
The Dynel covering was removed and the bulging foam was carved back to the proper contour. A new Dynel/epoxy surface was applied . . . with the thought that since the underlying foam had been expanded once in the oven, it would never expand again. Wrong again, says Roger. Although not as bad as before, he says it is continuing to "work" to some extent. The whole experience has created a new "If I do it again, I'll . . ." . Next time, he'll go back to the tried and true aluminum leading edges.

The second "disaster" was the use of an epoxy primer on the fabric covered surfaces. After the rudder, stabilizer, elevators, ailerons, center section, I-struts and trim tab were covered and finished to the point of final color coats, they were stored in Roger's hangar until the wings and fuselage could be completed. A rare Southern California cold snap brought overnight temperatures in the 30's — with the result that when Roger was next in his hangar, he was stunned to find the parts and pieces looking "just the same as if you'd taken a plate glass window and thrown a rock through it".

The fabric had to be stripped off all these components and a start-from-scratch recover job done. The only bright spot Roger could see in it all was that he had discovered the epoxy's low temperature characteristics before he had covered the wings and fuselage. The second go 'round saw a reversion to time tested procedures: Over the 2.7 oz. Dacron went a brushed coat of nitrate, four sprayed coats of nitrate, nine sprayed coats of butyrate and silver, another sprayed coat of nitrate, one coat of primer and two coats of polyurethane color. In between each were the usual hours of sanding.

The rudder is a painful story in itself. It was redone and recovered nine times before it met Roger's standards. Once, it was finally up to snuff — only to be blown over by a puff of wind and impaled on a piece of sharp metal. A couple of the repaintings were attempts to get Roger's personal logo just right. His company stationery features a leprechaun — which is reproduced on the rudder using a featherduster to dust stars.

(Photo by Ted Koston)
Rear cockpit of the Starduster.
Notice the tape deck below the
radio.



The interior of N2MR is unusually detailed for an open cockpit biplane. It is fully upholstered and the floorboards are raised so that all control runs are out of sight. The yellow and red color scheme flows right into the cockpit interiors — even to the padded instrument panels. All the instruments are inset and are the 2½” jobs, except for a full size airspeed in the rear cockpit.

The cockpit carpets are held down with Velcro and the upholstered side panels by snaps — so that all can be stripped out in a flash for inspection and maintenance. The bucket seat cushions are rolled and pleated and are removable in case parachutes are worn. In either instance the pilot and passenger's eye-levels are the same.

The baggage compartment has two sections — upper and lower — and is finished in mahogany. 100 pounds of baggage, Grand Champion trophies, etc. can be carried with ease. Of course, all the exposed metal in the cockpits — control rods, pedals, etc. — is plated. A transducer-operated fuel flow meter, accurate to 2% is one of Roger's favorite goodies — along with his four-track stereo tape deck. This is channeled into headphones which can be switched from stereo to monaural for use of the Narco transceiver. A snap container for extra tapes assures a variety of music for longer flights.

The airplane has a full electrical system, strobes, landing lights — and inverted fuel, oil and smoke systems. It has had all aerobatic restrictions removed by the FAA, making the Starduster a sort of gentleman's luxury/aerobatic/fun ship.

The bird came out weighing 1139 pounds empty and has a gross of 2000. Roger gives his performance figures as: economy cruise - 115 mph at 9 gph; 135 mph at 12 gph and 153 mph at 16 gph. Sustained climb, solo, is 1800 fpm. Stall is at 58 mph and maximum speed is 200 mph. N2MR carries 45 gallons of fuel.

THE MAN

Roger Rourke (EAA-Lifetime 28623), 5616 Corryne Place, Culver City, CA 90230, is one of those rarities —

24 OCTOBER 1977

a native-born Californian. In fact, not only has he always lived in Culver City, so did his father before him. Even his wife, Marilyn, is a native (Santa Monica). He obtained a Private ticket in 1965, learning to fly in a Cessna 150. Surprisingly, the first taildragger he ever flew was his Starduster Too. He did — or tried to do — the initial taxi tests at Chino, and after two days of trying to tame the beast, gave up, believing he had some terrible out-of-track condition with his landing gear. A friend with taildragger experience gave it a try and declared the Too to be near perfection. "That really made me feel bad!" recalls Roger. Some dual and a lot of taxi time eventually cured the problem.

The trip to Oshkosh was Roger's first and was the first time he and his wife had flown a private plane through the midwest. Both were tremendously impressed with the greenness . . . and after the drought California has been experiencing of late, didn't mind Wisconsin's showers at all. The Starduster was flown again in May of this year and had 43 hours on the new engine when it landed at Oshkosh. The only problem experienced on the trip east was the result of their first experience with 100LL gasoline. Some tips on leaning — and high country flying — from a helpful EAAer in Albuquerque took care of the situation.

The paint scheme of N2MR — yellow with stylized red flames licking down the side — is, as Roger points out, a direct throwback to the hot rod and custom car days of the 40s and 50s. Latter day custom car and van owners are just now "rediscovering" these wild old "flames". Perhaps all this is more than just symbolic of what is happening in the homebuilt (and also Classic) airplane world. Merely building and flying an airplane is not all that unusual any more. Now, those with a competitive nature — like the car people — are out to create a highly personalized machine that reflects their own personality, their own ego . . . the ultimate expression of personal wings.

Naturally, this trend would start in California.



CHUCK TYLER'S STARDUSTER TOO

*By Chuck Tyler (EAA 52391)
3029 Heather Rd.
Long Beach, Calif. 90808*

(All Photos by Bill Michael)

From my earliest childhood days when I saw my first biplane, I have always felt that I was born 20 or 30 years too late. Such were my feelings when I decided upon the Starduster Too. It was built to satisfy a personal desire to own a biplane, fly open cockpit, get a taste of "the good old days" and be able to partake in some real basic fun flying.

Working as an air traffic controller at Long Beach airport it was my pleasure and good fortune to meet Morgan Schrack (EAA 39114), a man I consider one of the most knowledgeable people in sport aviation today. In fact, it was his original Too that mine was patterned after. Throughout the entire project he was my guiding hand and constant advisor. Being able to watch him design and build the "Super Starduster Too" at his home not only brought my plans to life but added a lot of "ideas" too.

My airplane was built over a 40 month period consuming some 3500 manhours. Construction was done mostly in the garage but the wings, built during the winter months, were put together in the living room in order to obtain controlled temperatures on the wood and glue. During the course of construction, certain little things were changed for a twofold purpose: in order to increase performance and aerobatic ability and to provide

for my own custom touches and obtain a more pleasing appearance. One thing I learned in short order was that you can't have both. I was constantly sacrificing one for the other but, to me, the end result was worth it.

Power comes from a Lycoming IO-360-A1A swinging a Hartzell counter-weighted constant speed propeller. It is fed by full inverted fuel and oil systems so that unlimited inverted flight is possible if one so desires. Basically, the engine/prop combination is the same as that found on a certain certified two place aerobatic biplane (why argue with success?). Since experience has shown that the engine would tend to run on the hot side with this prop, two oil coolers were provided in the original installation. This proved to be the right combination as the oil temperature has always stayed well below red-line even during climb tests on some of the warmest days.

The engine mount has been shortened in order to bring the center of gravity and center of pressure closer together. The cabane struts were shortened in order to provide a more pleasing profile. Incorporated in the fuselage is an engine breather tube that runs out past the tail-wheel keeping the exterior free of any oil spray. Fuel and battery drains run through the landing gear cuffs along with the brake lines and exit clear of the structure. Tail feathers have been beefed up and braced slightly differently to provide a stronger, vibration free structure — something greatly needed in a Too. The external appearance of the fuselage was changed considerably, and in my opinion, resulted in one with very clean and well proportioned lines. An interesting feature is a front cockpit cover that provides a quick conversion from a one to two place airplane. It is custom molded of fiber-glass, as are the windshield frames, and fits so tightly that it hardly breaks the smooth lines of the cowling.

The wings incorporate four enlarged ailerons mounted



in ball bearings and the control system was consequently modified to provide desired responses. This has resulted in both a very good roll rate and smooth, light, positive controls. To me, the semi-elliptical trailing edge of the wings is the one thing that makes the Starduster design a classic beauty. A lot of people are reluctant to build the wings because of so many varying rib sizes. I made a routing template for the ribs that was very simple to construct and with one basic pattern to the rear spar and different trailing edge pieces, all ribs were routed out in a few hours.

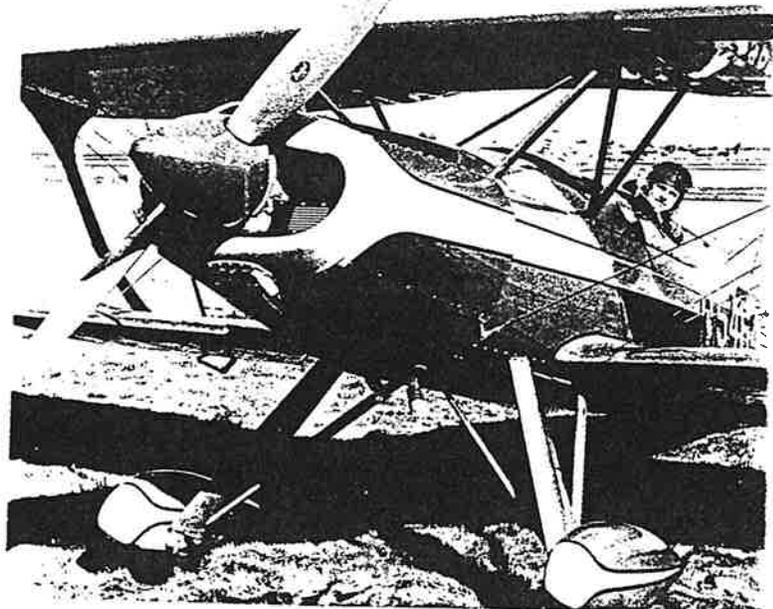
When it came to the interior, this was one part that I just had to have despite the extra weight. Both cockpits are fully upholstered in black naugahyde with the seats done in diamond pleats and the rest left smooth. The floors are covered with black nylon carpeting. Before covering, the fuselage was painted light grey epoxy and the few exposed members provide a striking contrast to the all black interior. Full instrumentation in both cockpits plus intercom make you feel right at home while providing a practical two place airplane.

The beautiful paint job is really something to behold and was applied by Morgan Schrack. I must confess it has ruined his reputation as a superb pilot. Everyone who sees it thinks of him as a painter now. Most people would swear it was done by a professional (would you believe a professional amateur?) and not in my back yard on calm days.

August 14, 1973 brought the first flight and this was handled by Morgan. Performance was great and only minor rigging changes were needed to obtain hands off flight. Every step of construction was very carefully planned, executed and checked over and there have been no problems or failures to date. This is one plane that truly flew off the drawing board. A rate of climb of 2500 fpm and 135 mph cruise make it a very good performing fun airplane. With 42 gallons of fuel in two tanks range is about 540 miles on cross country flights. Subsequent flight testing unveiled no undesirable characteristics and restrictions were lifted in December 1973.

There are two points that I would like to bring up. One is safety. If you are careless during construction with a saw or grinder, etc., your flying (providing that you are still in condition to fly) will be a lot less enjoyable. The other is through the years of construction, your flying skills usually deteriorate. Although you created an airplane and know every nut and bolt in it don't let this false sense of security lull you into thinking that you can just jump in your bird and fly away. Get some practice, lots of it. Don't be too proud to let someone else more qualified do the testing. Experience and knowledge go a long way, especially on a first flight. End of sermon.

I would like to extend my most heartfelt thanks to my wife Joanne for all her patience, to Morgan for his assistance and to all the other friends who helped in so many ways. There is one question that people always seem to ask and that is why I decided to build a Starduster Too. My answer is simply that I think it is the most beautiful two-place open cockpit biplane flying today. Nobody has ever argued the point!



Starduster Too

Classic Is As Classic Does

ARTICLE AND PHOTOS BY
BUDD DAVISSON

In many ways aircraft designers are like artists. For one thing, each has his own style which clearly identifies his creations as his own. Just as you can recognize Picasso by his refusal to let reality invade his paintings, you can recognize most John Thorp designs by the stabilator and flat center section. Gaugin's vivid bleeding colors are strictly his, just as highly swept tail surfaces are Ted Smith's.

And then there are the designs of Lou Stolp. Wings with a voluptuous, sweeping plan form combined with a wasp-waisted fuselage are Lou Stolp's signature. He clearly has a passion for flowing, delicate lines which give his airplanes an almost feminine presence. The net result of his love for the French curve and dislike for the straight edge is that Lou Stolp has designed some of the most classically beautiful airplanes sport aviation has ever seen.

The nice thing about classic beauty is that it is just that...classic. It never dies. It never grows old. And never has the concept of classic beauty been more alive than in Lou Stolp's Starduster Too.

If there is a sad aspect to sport aviation it is that we are mutating and expanding so quickly that those who have just discovered us can't help but overlook some of what went before. Part of this is because many have come into the fold recently because of the magical promise of quick-to-build airplanes that can whisk them over imaginary horizons with a minimum investment of elbow grease. The high

profile of the newer designs have swept some of the older ones off to the side where they aren't easily noticed. Lou Stolp's Starduster Too is one of those.

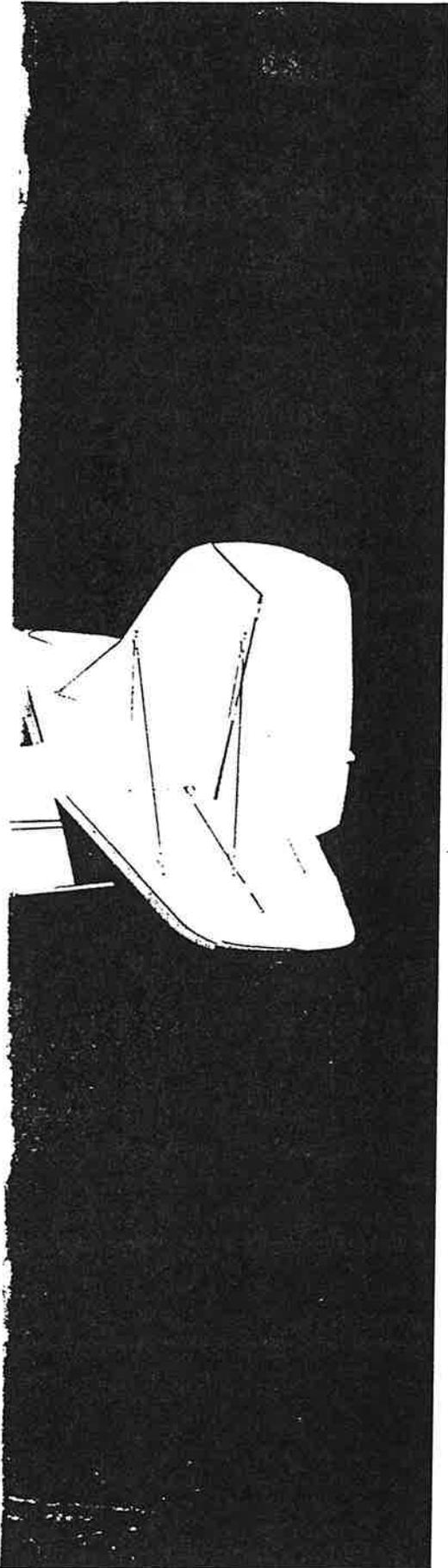
The Starduster Too (SA-300) was born in an era before the kit concept had taken root. In the early 1960s, airplanes were born as sheets of paper and piles of tubing and aluminum. Then it was up to the hand of the secondary-artist, the builder, to make it into a flying machine.

The Starduster was also born in an era before the urgency attached to A-to-B aviating had become so pervasive. Simply getting there had yet to become so important. Fun and the sheer love of being off the ground were the guiding principles behind Stolp's drafting pen. That and the urge to design the prettiest two-place biplane he could. And he did.

For some reason sport aviation seems to run in spurts. At one time we were overrun with Starduster Toos. Today, however, it's not unusual for a major fly-in to not have a single example in attendance although many hundreds have been built.

Maybe it was simply the fact that I hadn't seen a Starduster Too for some time that I was a little surprised when Brian Hanratty's showed up on our ramp at Scottsdale. I had forgotten how large the airplane is, or at least how large it seems, since it stands up off the ground at a meaningful angle like airplanes are meant to. With a 24 foot span, it is the same size as a Skybolt and two feet shorter than a Great Lakes.

I had also forgotten how its grace and nearly dainty features make it





seem somehow...well...it just seems to look light for its size. I guess I'd forgotten how downright pretty the airplane is.

There is a mistaken assumption that the multitude of curves which give a Starduster its beautiful form also make for a complicated structure when just the opposite is true. Lou Stolp wanted the airplane to be easy to build for the amateur and designed it accordingly.

The wings, for instance, use ribs which are band sawed or routed 1/4" plywood.

In an effort to keep costs down, Stolp eliminated the usual internal drag, anti-drag wires and replaced

them with a tubing truss (5/8 x .035 4130) angling from front spar to back that act as both compression and drag, anti-drag members. The builder jigs the wings to true dimensions, slips the tubes into position and drills the holes. From that point on, the wings are solid.

The fuselage is basic steel tube construction with nothing new or unusual. It was designed specifically for the amateur builder in the days before the sport aviation movement had given rise to professional shops or amateurs who were better than the professionals. The entire EAA organization was a tenth the size it is now so the average builder's ability level was still fairly

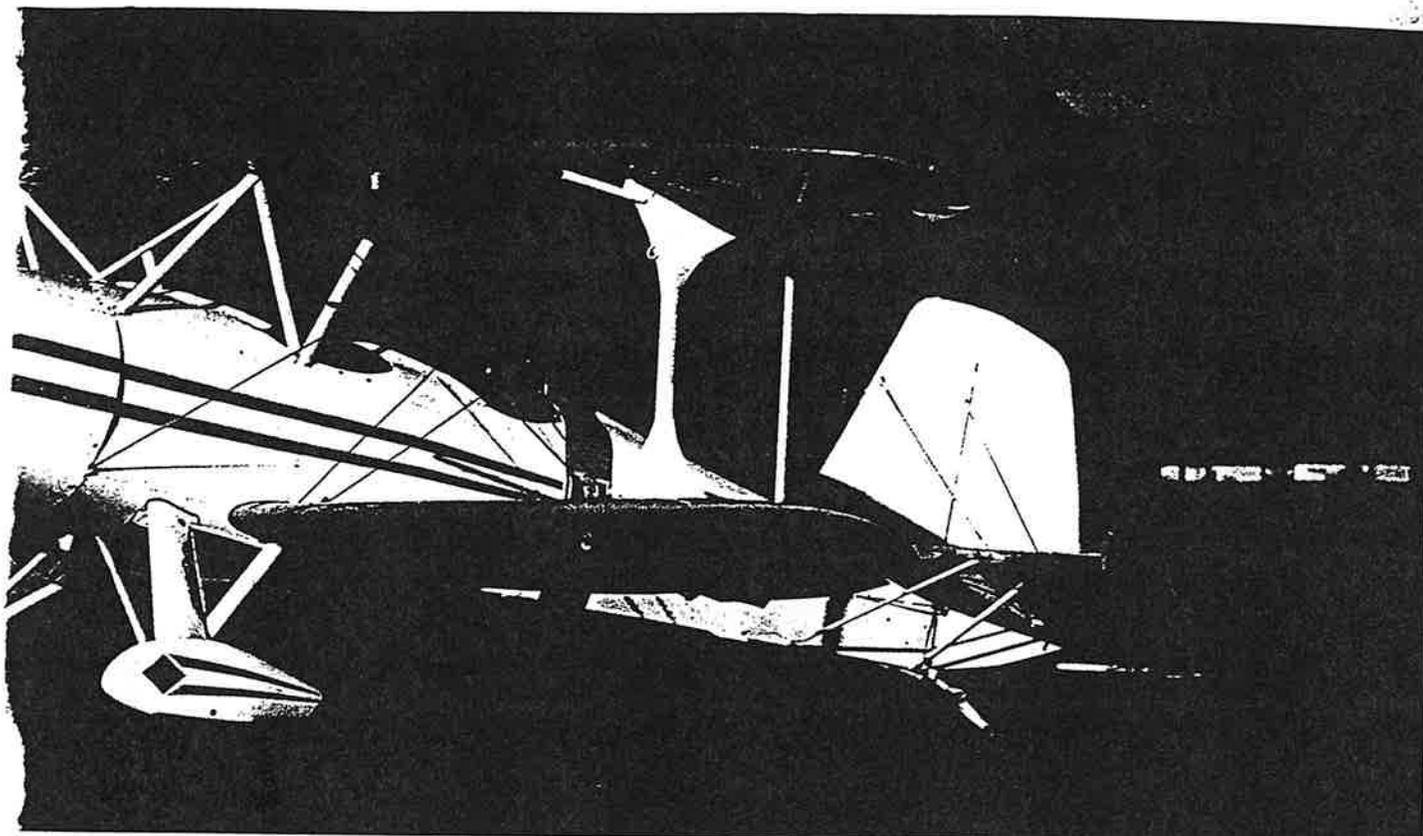


low and Stolp designed so that individuals would have little problem with his parts. For that reason the fittings and all other components are generally weldments comprised of flat stock or tubes. There is no machining required.

Stolp's philosophy was if it could not be done in a builder's backyard, he wouldn't put it in his airplane. This is one reason a critical engineer would look at some of the details and point out where a few pounds could have been saved by going to such and such a method. That is definitely the case, but then a backyard builder who owned nothing but an oxy-acetylene torch and a hacksaw couldn't build it.

The Starduster Too was the first successful sport aviation attempt at a two-place biplane design, which was a major step up from the many midget biplanes which had preceded it. Sport aviation was still in its infancy and the Mongs and Smith Miniplanes were pretty much the biplane standards with the Pitts coming on strong. But all of those were tiny, relatively hot little airplanes and Stolp wanted his airplane to be pilot-friendly, both in the way it flew and the way it fit the folks inside.

It was the desire to build a pleasant airplane that led to the Too's size and cockpit accommodations. With the rel-



atively flat-bottom M-6 airfoil and lots of area, he could keep the landing speed down which greatly simplified ground handling and pilot transition.

It was on boarding Brian Hanratty's airplane that I was once again reminded how much overall comfort is gained when an airplane is just a little larger and blood and guts performance is not the ultimate goal. Both cockpits are far wider than necessary for the average size person although they aren't terribly deep. A pilot who is well over six feet tall is going to stick out more than in something like a Pitts unless he moves the rudders and rearranges the seat accordingly. Actually, sticking out is rather pleasant because it gives just that much more visibility.

The center section of the top wing is so far above the front pit that in boarding it isn't even a factor and once inside it forms a convenient sunshade. Also, since the wing is built in three pieces with a separate center section, the view through the windscreen is unobstructed by cabane struts or brace wires.

Brian bought the already built Starduster Too less than a year ago. It is equipped with an IO-360 Lycoming (200 hp) and constant speed prop, both of which are low-time fugitives

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For reasons he can't quite pin point, Brian says his airplane is on the heavy side at 1,275 lbs. empty. Bill Clouse at Starduster Corporation says the usual four-cylinder Starduster will come in at about 1,150 pounds while the six-cylinder birds generally run, 1,250. Bill also said, however, people tend to get carried away with instruments, upholstery and other cosmetics and often get the airplanes up to as much as 1,300+ pounds. The prototype only weighed a shade over 1,000 lbs. with a fixed pitch 180 Lycoming and Clouse said the more meticulous builders can keep them close to that but few do. Having flown Brian's airplane at what was well over the design's original gross weight, it would be interesting to fly one which was light because Brian's airplane really performed even with the extra weight.

As I strapped into the airplane, I was very conscious of being able to move around with ease, a real change from doing the same thing in my Pitts. In fact, I think it would take something like a Stearman to have a cockpit with significantly more room than this one.

The width of the cockpit cut into the visibility just a little, but it was still on a par with most other tandem tail-draggers and better than some. The limited visibility is unavoidable with this type of configuration but is only a factor on the first couple of landings. After a few hours, every pilot learns quickly to get his head back during flare and look out both sides at the same time. It becomes second nature.

Priming with the boost pump until the fuel pressure needle came alive, I pushed the button and watched as the Lycoming coughed into life. I stood on the brakes for a second and then started down the narrow ramp area towards the taxiway. The airplane was moving straight ahead, but I quickly noticed there was no pressure on the rudder pedals from the tailwheel springs. None whatsoever. So I started playing with the rudders and found I had to have them practically against the stop before the tailwheel springs took hold and the airplane started turning.

Although Brian has a lot of high performance and multi-engine turbine time, he is not a high time tailwheel pilot. In fact, he says he only has about

150 hours tailwheel time over the past couple decades and a third of that is in the Starduster. Until I started complaining about the lack of tailwheel steering, he said he thought that's the way it was supposed to be. Wrong!

Being something of a chicken I told him I didn't feel right flying someone else's airplane when I felt something as critical as the tailwheel steering was that far out of the norm. I had no idea how well the airplane handled on the runway and I wasn't about to find out with what was basically a free swiveling tailwheel. Lose a brake and I'd be in deep trouble instantly.

So, we swapped seats and I moved up front.

As the tower cleared us and Brian brought up the power, I was on the controls as if I was riding herd on one of my Pitts students. I was pleasantly surprised at how quickly the airplane accelerated and how little rudder input it took to keep it straight. I was even more surprised at the visibility over the nose with the tail up.

It had been a long time since I had flown a biplane that didn't have symmetrical airfoils or that had so much wing area (165 sq. ft.) so I think I had forgotten what a biplane feels like when it actually flies off the runway rather than blasting off. Takeoff in the Pitts is a ballistic affair. Takeoff in the Starduster is purely aerodynamic and feels more natural and "organic." It actually lifts itself off.

As I took the controls I kept one eye on my watch and the other on the altimeter. The airplane seemed to be climbing much faster than I expected and, in fact, felt as good as my Pitts so I timed it. Although my airspeed may have had a static port problem and I wasn't certain the 85 mph I was holding was accurate (best rate according to the literature), we were doing nearly 1,200 fpm. This is a very respectable climb considering we were over normal gross by easily 200 lbs.

With that kind of climb rate we were at altitude long before we got to the practice area and the nose was pushed over into cruise. With the power set at about 75% we were truing a tad over 130 mph. I could have measured the speed quite accurately by the dynamic pressure on my forehead since I was sitting too high for the tiny front windshield. Occasionally I'd get nailed by a raindrop which at that

speed is an experience!

As I started to rack the airplane around in turns I was once again pleasantly surprised. I didn't remember the ailerons being so light or responsive. The airplane is no Pitts in the aileron department, but it responds quite nicely. As I was doing aileron rolls (I couldn't get the belt tight and wanted to stay positive), I found the max roll rate wasn't terribly high, probably around 90-100 degrees/second, but it was nonetheless a nice solid rate that didn't slow down on the top of the rolls.

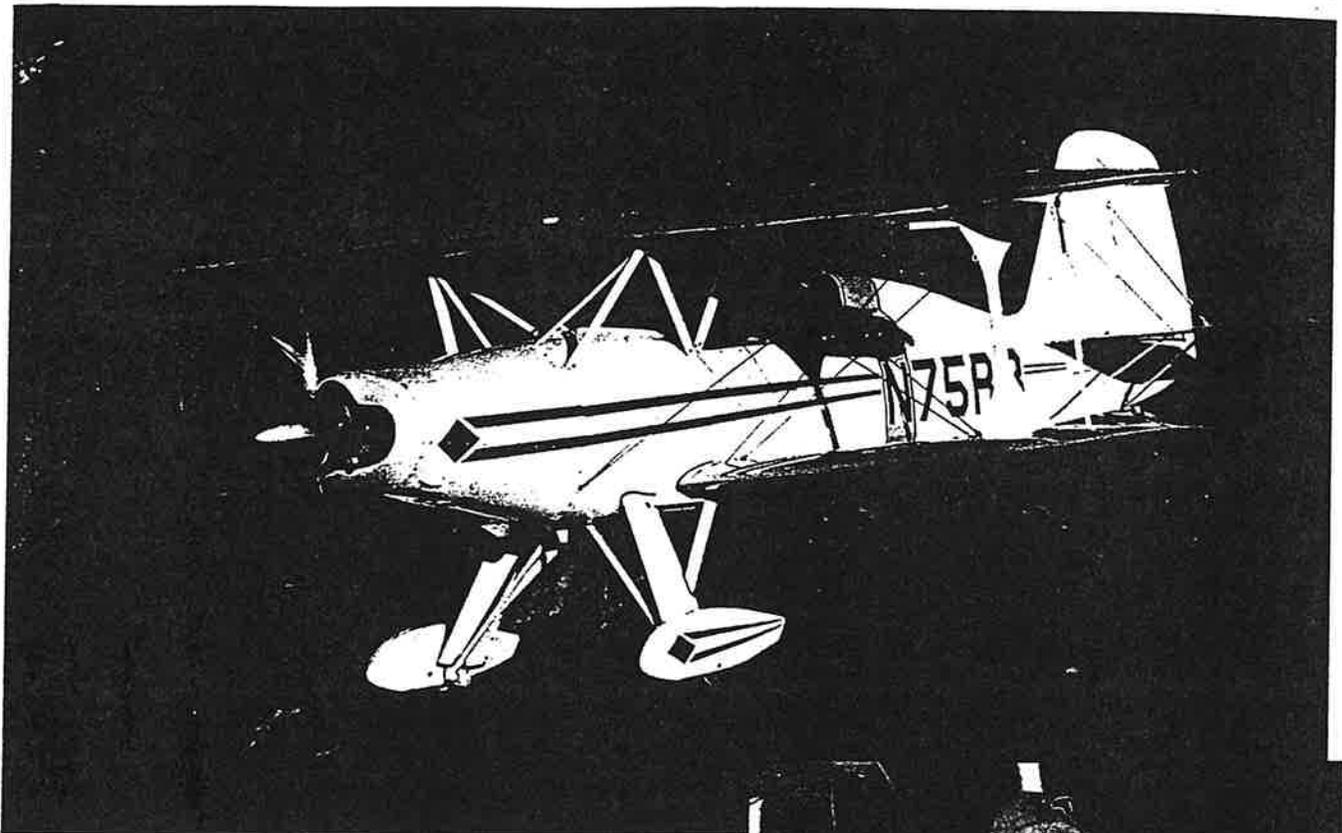
The first time I looped the airplane I put my head back to catch the horizon and found myself looking into the bottom of the top wing. I had forgotten it was there! The airplane trucked over the top as solid as bricks from an entry speed of 150 mph and we caught our own slipstream on the recovery. I had simply used what felt good and Brian said that worked out to 3 Gs on the meter. With that light wing loading and 200 hp it just doesn't need much G to make it over the top with style.

It's important to remember that Stolp never designed the airplane as an aerobatic mount, even though it is stressed to plus and minus 6 Gs (9 Gs ultimate). But, of course, that hasn't stopped folks from yanking and banking as if it was designed for the sport. In fact, at one time there was a problem with people working the airplane too hard and tail cracks began to occur, but there have been no recent problems.

The literature gave the stall speed as 56 mph, which is really low for this type of airplane and I was curious to see if it would live up to its advertising. As the speed worked its way down, the controls became only a little lighter and less effective. Then it burbled and buffeted a bit before the stick was on the stop and the nose was bobbing up and down. The airspeed read 58 mph and matched Brian's in the back. Very nicely behaved!

At least at that speed the raindrops didn't hurt as much!

Brian had been talking about how quickly the airplane fell out of the air and frankly it had been so long since I had flown one, I couldn't remember. So, when I came abeam the runway numbers on downwind, rather than going for a power-off landing I left a little throttle in it. That was a mistake. As we came around the horn on to final it was obvious the airplane was



staying in the air much better than my S-2A and I had much more altitude than I wanted. A gentle left slip took care of that and I let it settle down to about ten feet before giving it back to Brian. Having had some bad experiences with strange airplanes and bad landing gear geometry I didn't want to touch down and then discover this particular airplane was a tiger on the pavement and had no tailwheel steering to help me out.

Again, I was worried about nothing. As the airplane touched down it was obvious only minimal rudder inputs were needed to keep it straight, although even those inputs would have been smaller had the tailwheel springs been stiffer. With a stall speed under 60 mph and a fairly steep deck angle, the airplane touches down about as slowly as any high performance two-place biplane can. Since zigs and sags are a function of the square of the speed, getting it on the runway slow goes a long way towards making it easy to handle. Couple that with what is obviously good gear geometry and you have an airplane that is only slightly harder to land than a Citabria. Once the pilot acclimates to the limited visibility, that is.

Even utilizing ready to cover wings (\$9,790) from Starduster Corporation and completely finished welded components (\$9,900), it is still not going to be a quick-to-build airplane, at least not as the composite-generation defines it.

However, there's not a composite bird out there that can give wind-in-the-wires thrills like the Starduster. And even though a lot of those new fangled composite machines are as sleek as a rifle bullet, a lot of pilots still feel those kinds of airplanes are missing something. They may offer awesome performance but they don't speak to the soul. Their beauty is not of the classic mold.

Biplanes are forever and none is prettier nor more classic than the Starduster Too.

Lou Stolp

Lou Stolp's beginnings in aviation started when he began badgering pilots for rides at Mt. Holly Airport in Peoria, IL. It wasn't anything formal, just a kid doing what he could to get into the air



Brian Hanratty

without it costing anything. The year was 1935 and Stolp was 15 years old.

Then a few years later, Stolp found himself in the air much more than he wanted...as an aircrew gunner aboard a B-17 in Foggia, Italy with the 15th Air Force. But all the negatives of being in a war didn't tarnish his love affair with aviation and he had barely returned to the States when he began taking flying lessons, finally soloing a Champ in 1946. That was the same year he opened an air repair station at Compton, CA.

Compton Airport was to remain his base of operations for the next 15 years and it was there he was introduced to the world of the homebuilder.

"I had this old Champ fuselage in back and a guy came in to buy it. I asked him what he was going to do

with it and he said he was going to build something called a Stits Playboy.”

This was about 1950 and Stolp had never heard of anyone building their own aircraft, but in checking it out, found it to be a fact.

“I figured if he could do it I could too. So I contacted Ray Stits. It turned out he needed a set of wheel pants for his Playboy so I traded him a set of Luscombe pants for a set of plans.”

He finished the Playboy in short order and then one day started thinking about what kind of airplane he'd really like to own. He'd always liked the elliptical lines of the Heinkel bombers he'd seen in the war, but he liked biplanes too.

“I didn't start off with anything in mind, I just drew what I wanted. I started with a place to sit.”

His second airplane, the SA-200, was a two-place, side-by-side can-

tilever machine with folding wings. But he never finished it.

“Someone walked in the shop one day and said, ‘Why would you want to do something like that?’ so I pushed it to the side and forgot it.”

The SA-300, dubbed the Starduster Too, was a different story. He started it in 1960 and finished it a year later. He was just in time to be part of the major build-up of the EAA and the sport aviation movement. The airplane became one of the most popular designs of the era.

He sold the repair station business to his partner and moved to Riverside Airport where he established the Stolp Starduster Corporation. From that time on his business was supplying plans and parts to people who loved little biplanes. In the early 1970s he sold the corporation to Jim Osborne who in turn sold it to its present owner, Bill Clouse, in the early 1980s. Osborne

added the Akroduster series to the line. Today Clouse is still on Riverside Airport and is keeping a proud bird's legacy alive by supplying a full range of parts and components.

Besides the Starduster One and Too, Lou also designed the little Starlet, a single place, open cockpit parasol that is the very embodiment of the subtle Stolp design touch. A little known design, the V-Star was a single place, small engine (65-85 hp) biplane similar in line to the rest of the Stardusters but was designed to handle like a Champ and satisfy the urge for open cockpit aviating without the pilot demands which often accompany it. It came late in the biplane era and never caught on, which is a shame because it was a fine flying little airplane.

Lou Stolp lives not far away from Riverside secure in the knowledge no one has yet built a prettier biplane. ♦



Girl San

By Lucille Boyles
EAA 18466A

(Photos by P. Dean Reed)

"Girl San" — both of them — the airplane and Lucille Boyles.

IT FLIES! THESE were the first words I could understand after my husband, A. C., got on the ground after flying our new "Starduster Too." I had quite a time as he extolled all of its virtues.

This project was a lifetime dream and ambition to build and fly his own plane. If all came true on February 8, 1969 out in the wild blue yonder at Mojave, Calif.

For two and one-half years, our home became a collection of swap meets, words of advice and just "plane" envy of people who wanted to be in our shoes. We were subject-

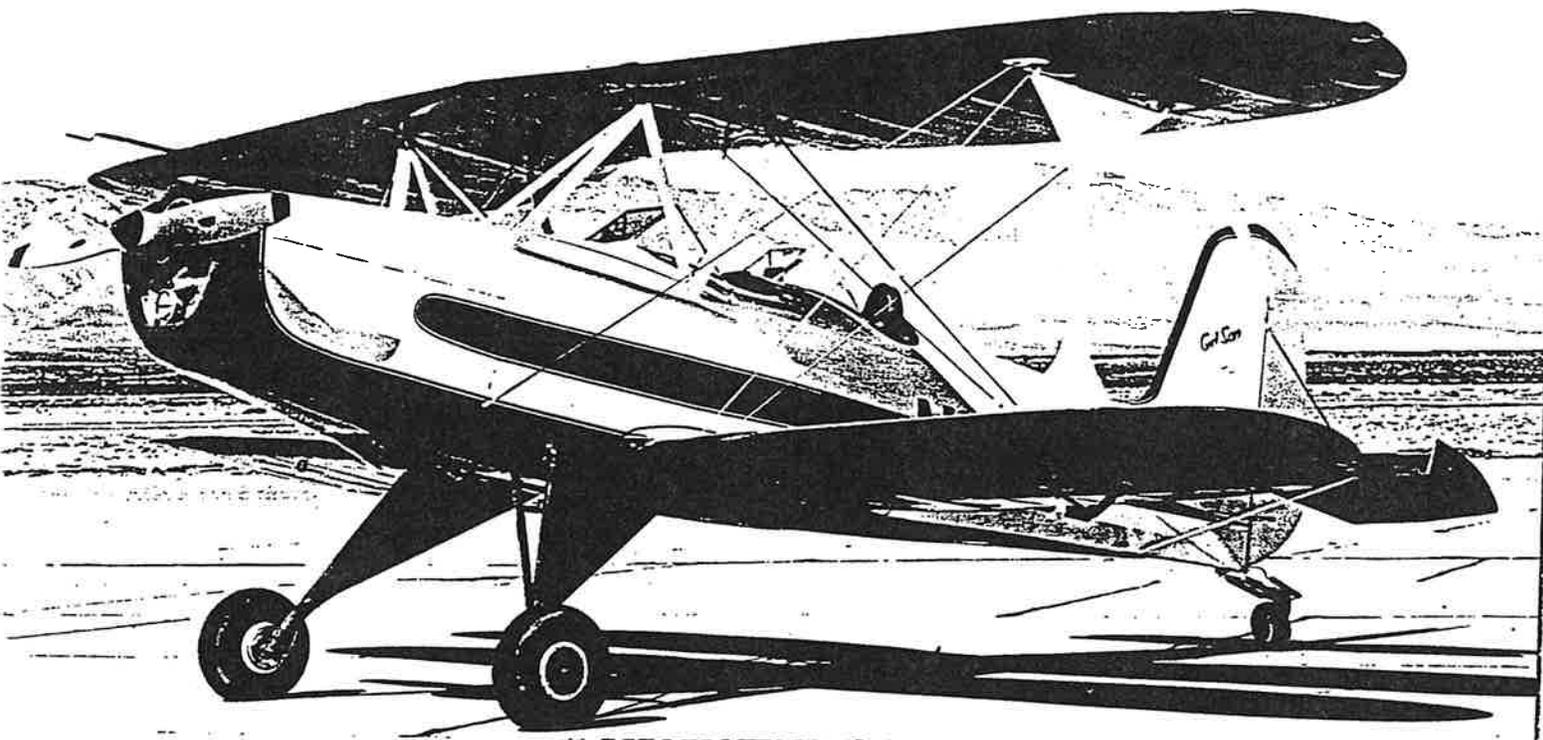
ed to sessions of questions and answers from all concerned.

The big question, which airplane to build was one thing we had to do some looking into. Type was not a problem; we knew it must be a biplane. We had both flown Stearman's and could remember the thrill of the great outdoors, but we also remembered the coffee stops to thaw out. Well, decisions — which biplane would we build? We looked, read and visited. The reading was really something because we wanted the vital statistics for the airplanes. Have you ever found them to be quite as

accurate or impressive as the designers claim? I am not complaining about this, as I have long since joined the ranks of the story tellers, especially about our baby.

We picked the "Starduster Too" because it was a biplane, two-place, easy to handle and the type of construction was well within our capabilities. Another reason — we both love to be out in the open and, believe me, we would be together.

We went out to Lou Stolp's hangar at Flabob to ask questions about his little biplane and ended up buying his plans for the "Starduster Too." This was on July 17, 1967. The actual construction started the next payday. Before we could start we had to do some rearranging in the garage so that we could keep our cars and the airplane out of the weather. We managed this by way of a surplus bomb hoist attached to the center of the garage with pulleys to lift the airplane. Of course, we started with the fuselage and it took shape fast.



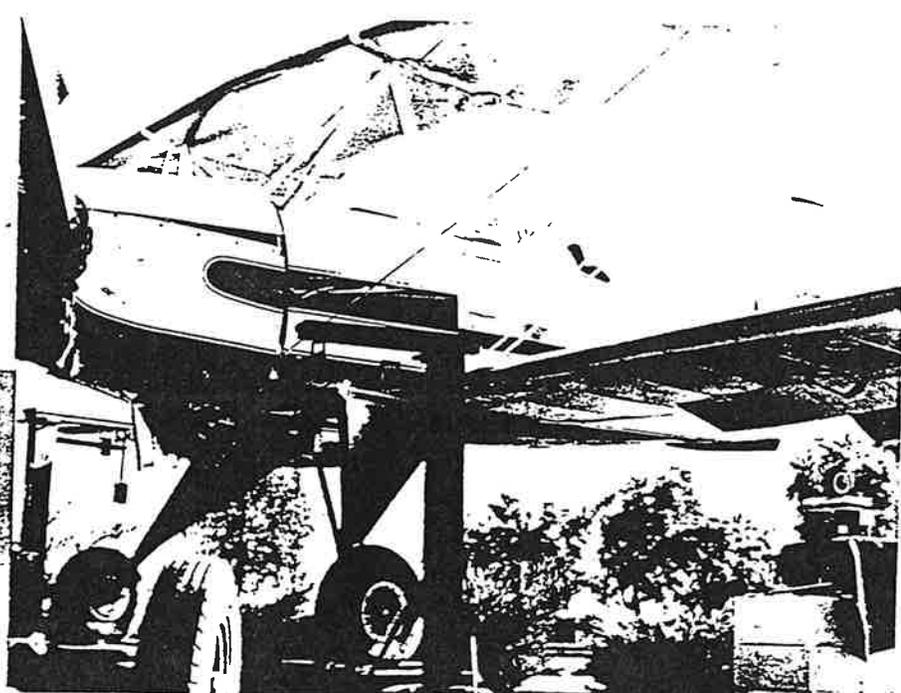
(Color Photo by P. Dean Reed)

The underside of "Girl San" is completely red, and not noticeable when the aircraft is viewed from the rear.

I really must tell about the landing gears, of which there were three. Of course, the first two were what I call "conveniences", as they were used to move the airplane about while it was being built. We could not keep the gear on the airplane and move it in and out of the garage. It also gave me a chance to do something in the house rather than helping to move the airplane about. We used a set of wheels from our old lawnmower for the first gear. The second was made of turned wood wheels with garden hose as tires. The third was for flying, so all of the people who were concerned about the gear can rest easy now.

A. C. worked only on weekends and holidays. Even then he would lose time when unnecessary things like buying a new truck would intervene. The truck was intended to pull our "project" out to Mojave. Sometimes, even clipping the lawn seemed to get

(Continued on next page)



Weight and balance checks on the aircraft were run in the driveway "workshop."

A. C. Boyles, the builder, takes a moment to relax in the pilot's seat. The ship at this point was ready for cover. Note the cut-out plywood wing ribs.

GIRL SAN . . .

(Continued from page 23)

in the way. As work progressed, we began to have "open house" on weekends and A. C. always had plenty of watchers and advisers. This was especially so with the little ones in our neighborhood. You could tell by their comments that we were well discussed at their dinner tables.

We turned our garage into a hangar. One bedroom made a nice place for those beautiful wings, the engine and other bits and pieces. The airplane also served as a class project for the students my husband teaches at Glendale Junior College in his A & P course.

During this time I became a parts chaser and someone to scold when all else failed. Being the inspector, I can also be very pleased with the finished product. There is one thing every wife must learn and that is to be happy, helpful and to take scolding well when her husband is building an airplane.

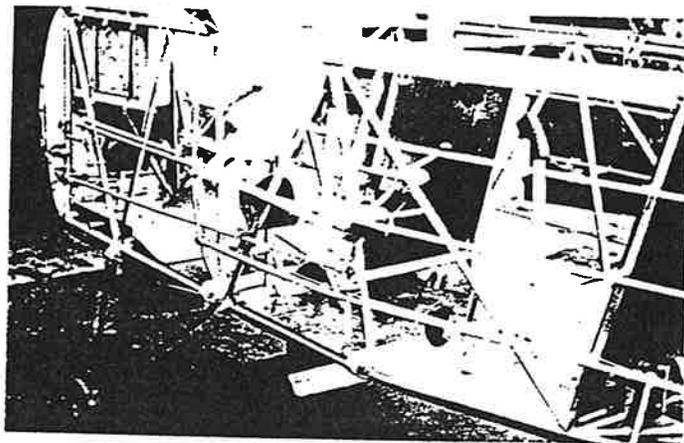
The "Starduster Too" is powered by a 150 hp Lycoming O-320-A1A. With its Sensenich M74DM-0-60 propeller, it climbs at 1500 fpm., and it cruises at 120 mph at sea level. It has a full IFR panel, navigation lights and 44 gals. of fuel for cross-country. The finish is nitrate and butyrate over dacron. The only deviation from the plans is the installation of ailerons on the lower wings only, but they were enlarged proportionally.

All in all, I cannot tell how much this means to both of us. The thrill of perhaps flying our own airplane to Rockford this year! The fact that it will be our own "Girl San", my husband's nickname for me, adds to the pleasure. So, when you see our white and red pride and joy, remember that you too can build one! There is plenty of help through EAA members and your own friends.

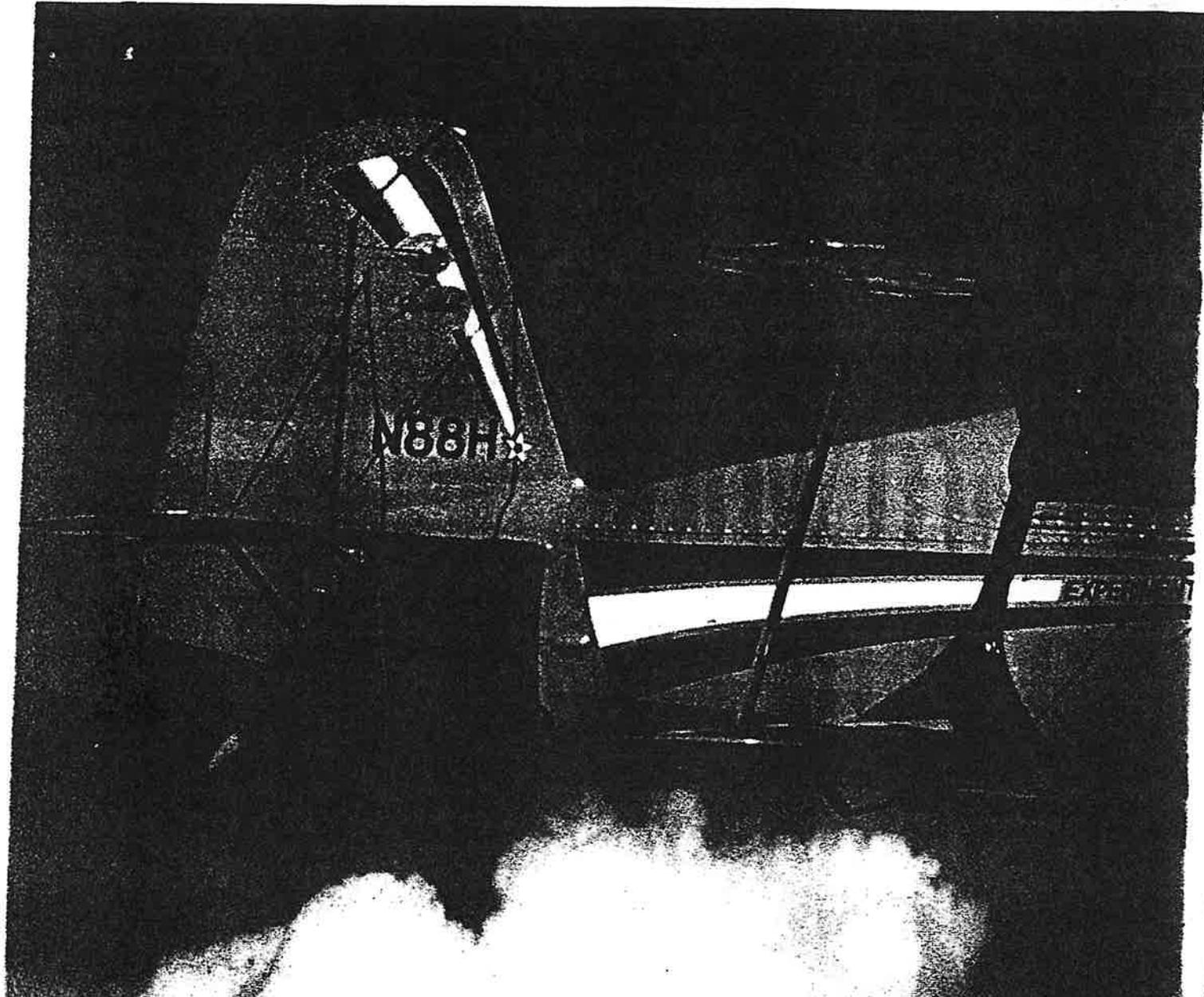
We are planning our vacation with "Girl San" as the mode of transportation. Of course, Rockford would be our first stop. After that, wherever our fancies take us for the greatest of four weeks will be a thrilling adventure. ©



On its dual-wheel "landing gear", the "Starduster Too" put on enough mileage in and out of the garage during construction. Engine and flight controls are seen in the fuselage structure.



Boyles "Starduster Too", "Girl San", N-1189B.



★
GENE HUDKINS'
Starduster Too ★

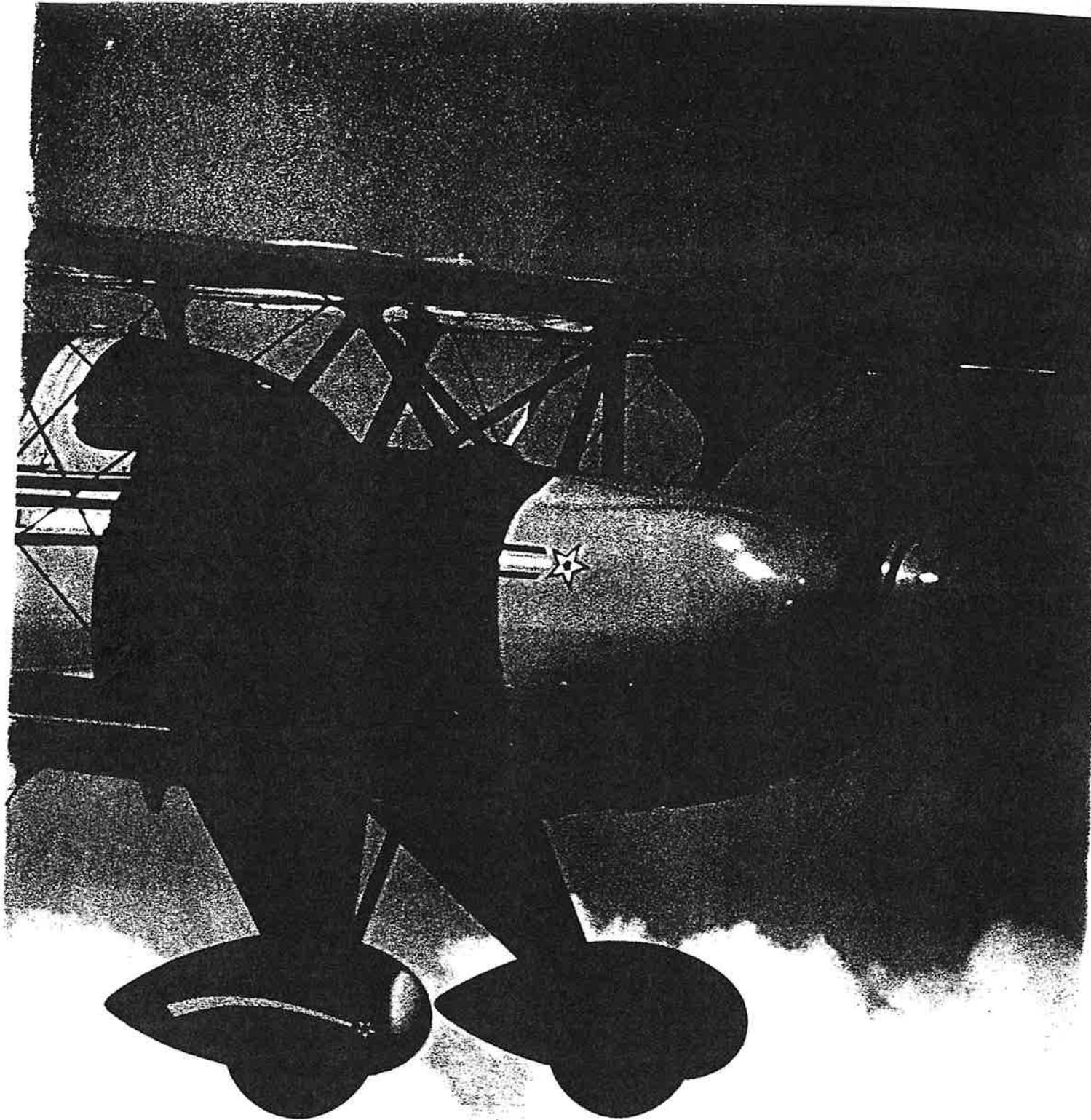
By JACK COX

Airplanes built from plans, particularly those from the early days of homebuilding when a minimum of systems and secondary structural details were provided, are very much a reflection of their builder's experience and desires. No two of

them are exactly alike. The beautiful Starduster Too you see pictured here is a perfect example, so we will start with the life and times of the EAAer who created it.

Gene Hudkins was born in St. Louis in 1926 but grew up in rural

Nebraska. Interested in aviation from his earliest years, he built models as often as he could scrape 20 or 30 cents together to buy a kit and a tube of glue. Sports and cars occupied much of his spare time once he became a teenager. He



Mike Steineke

joined the Navy when he was 17 and spent the last year of World War II as an aircraft mechanic and gunner. When his hitch was over, he returned home to attend the University of Nebraska-Omaha. A fine athlete, he played varsity foot-

ball and baseball and hoped to become a coach after he graduated in 1950 . . . but after interviewing for a position at a rural school and learning that it paid just \$1,800 per year, he decided to pursue another career path.

While at the university, Gene had taken advantage of the G.I. Bill to also earn his Private and Commercial pilot tickets, as well as an A&E license. Through aviation friends he learned that pilot/mechanics were in demand in South

varied, but it is common knowledge in the aviation world that many of the non-skeds have been employed by the government to support what the general news media likes to dramatize as "covert operations." To any suggestion that his career involved such activities, Gene simply smiles . . . and reiterates that he has had a "colorful" life. He retired 8 years ago when he reached the FAA's age 60 limit for airline pilots and moved to Navarre Beach, FL near Pensacola.

"I like the area for the beaches, the water, the boats and the fact that it is not very congested," he says.

In parallel with his aviation career, Gene has been actively involved in a number of other activities over the years . . . made possible in large part by the free time airline pilots enjoy. Much of his Navy time was spent in California during the heyday of the hotrod and he was greatly influenced by that type of "homebuilt." When he returned to the Midwest, he began building up his own '39 Ford coupes and racing them on dirt tracks around Omaha, Lincoln and Kansas City. He also raced motorcycles for a time . . . until his children began coming along and he realized it " . . . was time to give up some of his toys." His love affair with cars and racing would continue on a more sedate level, however. He has owned a number of sports and custom cars over the years and always tries to make the pilgrim-

age to Indianapolis each May. Boats have also occupied their share of Gene's leisure time, and some of their construction techniques would ultimately serve him well in aviation.

Personal flying has been still another parallel stream in Gene's life. He learned to fly in Cubs and Champs in Nebraska and got a lot of time in older biplanes . . . Travel Airs, Wacos and such . . . because in the late 1940's they were ridiculously cheap. This was before the antique airplane hobby came into being and the old biplanes were simply "junkers" left over from the '20s and '30s. They were difficult and expensive to maintain compared to the new Cubs and Champs, but that was not a problem for Gene since he was an A&E. Later, the interest he developed in old airplanes would become a hobby and he would restore a number of them. Most notable was the Curtiss-Wright Travel Air 16E that Willy Ropp has owned for years and now operates on floats in Florida. Gene bought that airplane on its back in a wheat field in Michigan in the mid-1950s, trucked it to Miami and restored it. It was written up in Bill Sweet's magazine, *Wingspan*, at the time.

It takes some head scratching for Gene to recall all the airplanes he has owned or had the opportunity to fly at one time or another. He has owned most of the early Pipers . . . J-3's (including a Clipwing he later sold to

Charlie Hillard), the J-4, J-5 . . . a Champ, the aforementioned C-W Travel Air, a Waco F-2, Porterfield, Funk, etc. He says that his early days in the Miami area were especially memorable because about every type of aircraft imaginable was available there, and having a commercial and, later, a transport license and an A&E (later A&P) ticket opened all sorts of doors for him. It was always easy to trade a little mechanical work for some stick time . . . or to get to fly a B-17 full of vegetables over to the Bahamas.

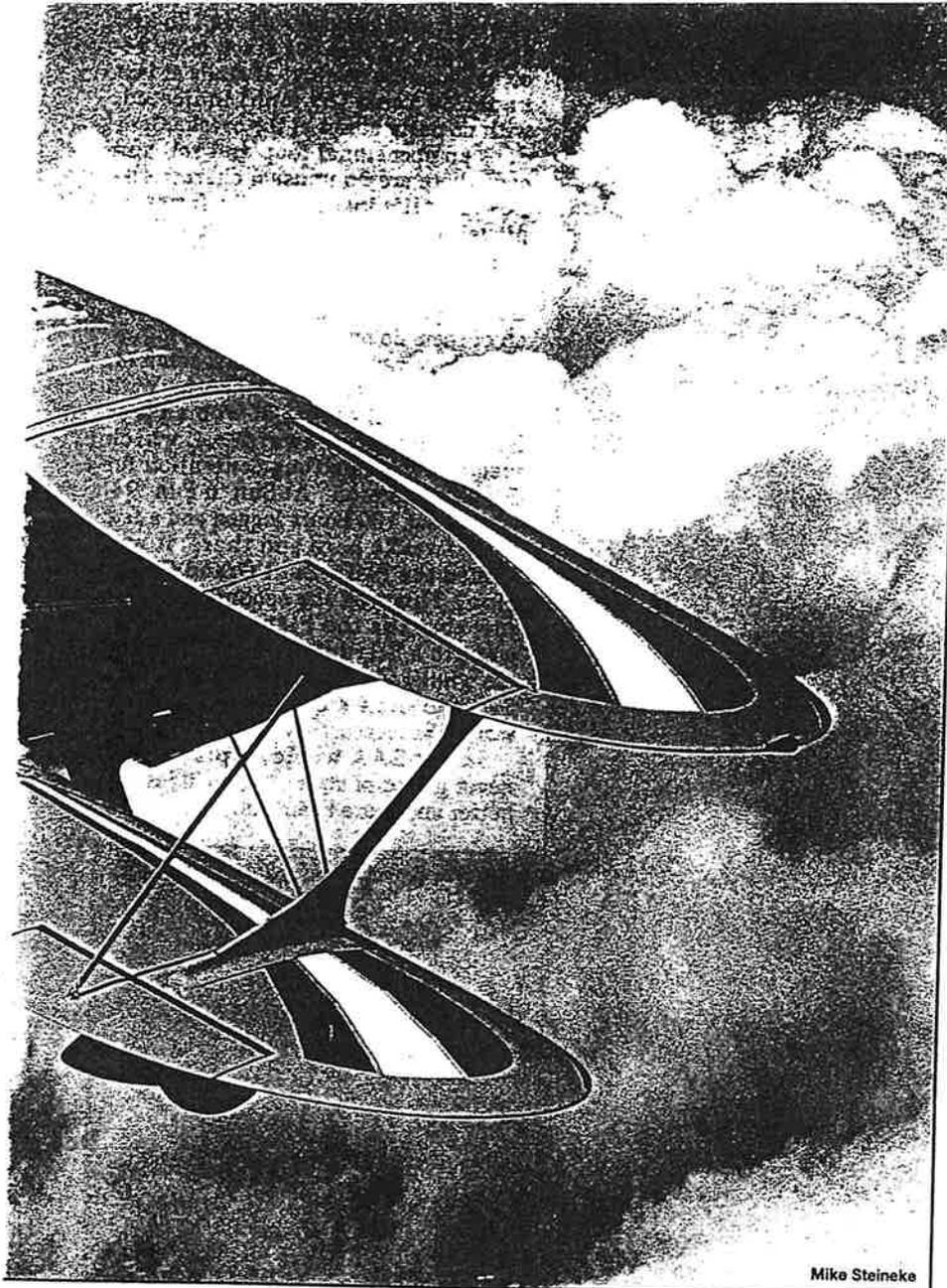
Like most of us, Gene has always retained a soft spot in his heart for the airplanes of his youth, the airplanes he daydreamed about and built models of in his grade school days. Mostly biplanes, they are still his favorites . . . and that, of course, leads us directly to his Starduster Too. He was instantly enamored with the curvaceous beauty when the first photos began to appear in print in 1966, and he ordered a set of plans from designer Lou Stolp in the early 1970's. Living near Ann Arbor, MI at the time, he began making parts . . . and hauled them around from place to place over the next decade and a half until he retired in 1986. At that point he made the Starduster his top recreational priority and really got down to work on it.

Gene set several goals before he began building what would become

Gene Hudkins



Jim Koepnick



Mike Steineke

N88H. As an A&P he was well aware of the desirability of good access to an airplane's innards for inspection and maintenance, so he was determined to build in an adequate number of inspection plates and panels, and make liberal use of nutplates so he could strip the fuselage down in a matter of minutes. As a life-long airplane lover, aesthetics were very important to him, also. The beautiful semi-elliptical wings had been the feature that had originally attracted him to the Starduster and he wanted the fuselage to be equally curvaceous. Specifically, he wanted a "blended" look . . . nice, smooth curves from nose to tail. He had the familiar Stolp Starduster headrest/turtleback that almost all builders use, but he made the remainder of the fuselage fairing himself. After the ba-

sic airframe was completed, he reverted to his boat building experience and used wood to fair the fuselage to the desired shape. Molds were pulled off this temporary secondary structure and used to make the fuselage cowl and skins. Readily available 7-1/2 oz. boat cloth and resins were used, plus hours and more hours of sanding and finishing. Gene says he figures he suffers a 10 to 12% penalty in weight over using aluminum, but could not have achieved the shapes he did with fiberglass. Advantages included a ding resistant surface, built-in NACA scoops and an easy medium to modify and add to when he dreamed up something new. He used the same materials to make all the little streamlined fairings around the ends of the cabane struts, the lower wing root fairings,

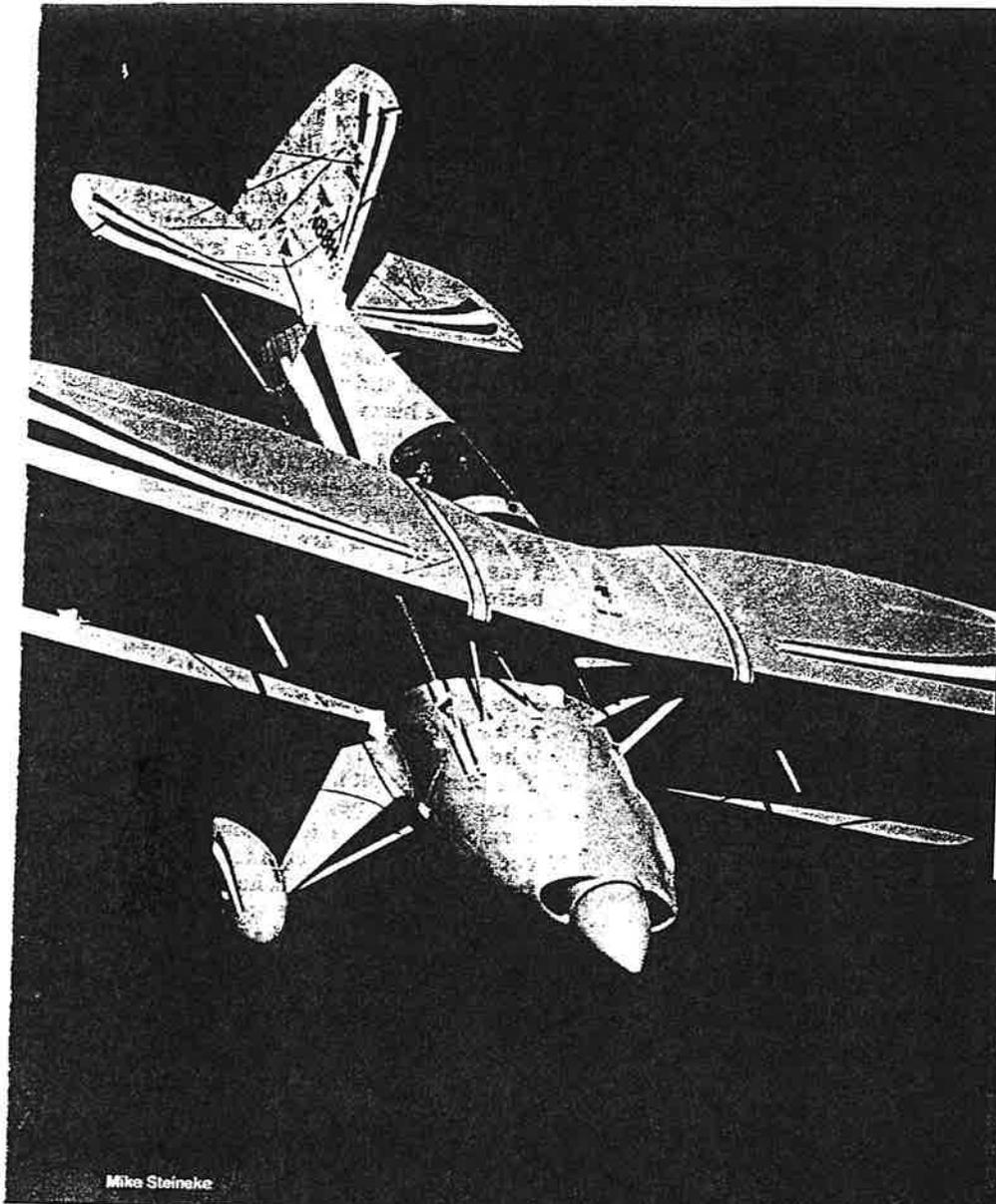
his wheel pants and landing gear leg fairings. The wheel pants and, especially, the gear leg fairings are not typical of Starduster Toos, but, rather, more in appearance like those of the aircraft of the 1930s. This was part of Gene's aesthetic goals for the airplane . . . a blending of modern elements such as the use of a flat engine with the classic look of F-2 Wacos and such from aviation's golden age.

Still another creative use of fiberglass involved the rudder and elevator trim systems and the 2-piece canopy. Instead of a heavy, complex mechanical trim mechanism, Gene used the little lightweight MAC electric trim servos, built right into the elevator and rudder. They work perfectly, he says, but the tabs, themselves, are gross overkill. They could be quite a bit smaller, he believes. The canopy is completely unique to the airplane, with everything . . . the fiberglass frames, the tinted Plexiglas™ bubbles and the latching systems . . . designed and built by Gene and a friend in the Norfolk, VA area who is an expert in plastic forming. The front cockpit bubble, because of its compound shape, had to be vacuum formed, while the less complex rear cockpit glass was stretch formed. The front and rear cockpit canopies appear to be one piece, but are not. The front one can be removed and a cover can be attached over the forward 'pit. A special windshield was made up to fit onto the rear cockpit canopy when Gene wants the airplane to appear to be a single placer.

All of this . . . the cowling, the canopy and the fiberglass fuselage skins . . . can be zipped off in about 30 to 45 minutes, leaving the airframe fully exposed and accessible for annuals or maintenance. Everything screws into nutplates so an electric screwdriver is a very desirable addition to the Starduster's tool kit.

The engine is a Lycoming IO-540 out of a wrecked Aztec. Gene gave it a chrome major and installed one of Hartzell's aerobic constant speed propellers. Having rebuilt and hopped up engines since the days of the flat-head Ford V-8s and the big aircraft radials, the six-cylinder Lycoming presented little in the way of a challenge to him. He had an outfit in Detroit bend up his stainless exhaust system, and a Christen inverted oil system was purchased and installed. The flop tube for the inverted fuel system is in the 26 gallon fuselage tank . . . and a 17 gallon tank is mounted in the center section. A cowl flap was built in, but has proven unnecessary for any operation other than long, hard climbs on the very hottest days.

Inside the cockpit, the panels are



Mike Steineke

power, it still indicates about 125 kts. (144 mph), so that is a much more acceptable cruise setting. It stalls at just under 60 knots (69 mph) indicated, with no nasty antics at the break. Gene does an occasional loop and roll and says there are no unusual characteristics . . . "It's just a straight forward, pleasing airplane to fly. It's a little blind when you flare for landing, but once down, it tracks straight. It's a taildragger and demands the attention all of them do on rollout," he says.

Gene completed N88H last summer, just in time to get it to Oshkosh. With the paint still drying, it won a Plans Built Champion award . . . which meant it was in strong contention for Grand Champion. At Sun 'n Fun '94, with about 100 hours logged and a few little tweaks here and there, it was named the Plans Built Grand Champion. This was the second year in a row that the top Plans Built award went to a Starduster Too. Last year the winner was Richard Miles of Rome, GA, and Gene's 88H was certainly a worthy successor.

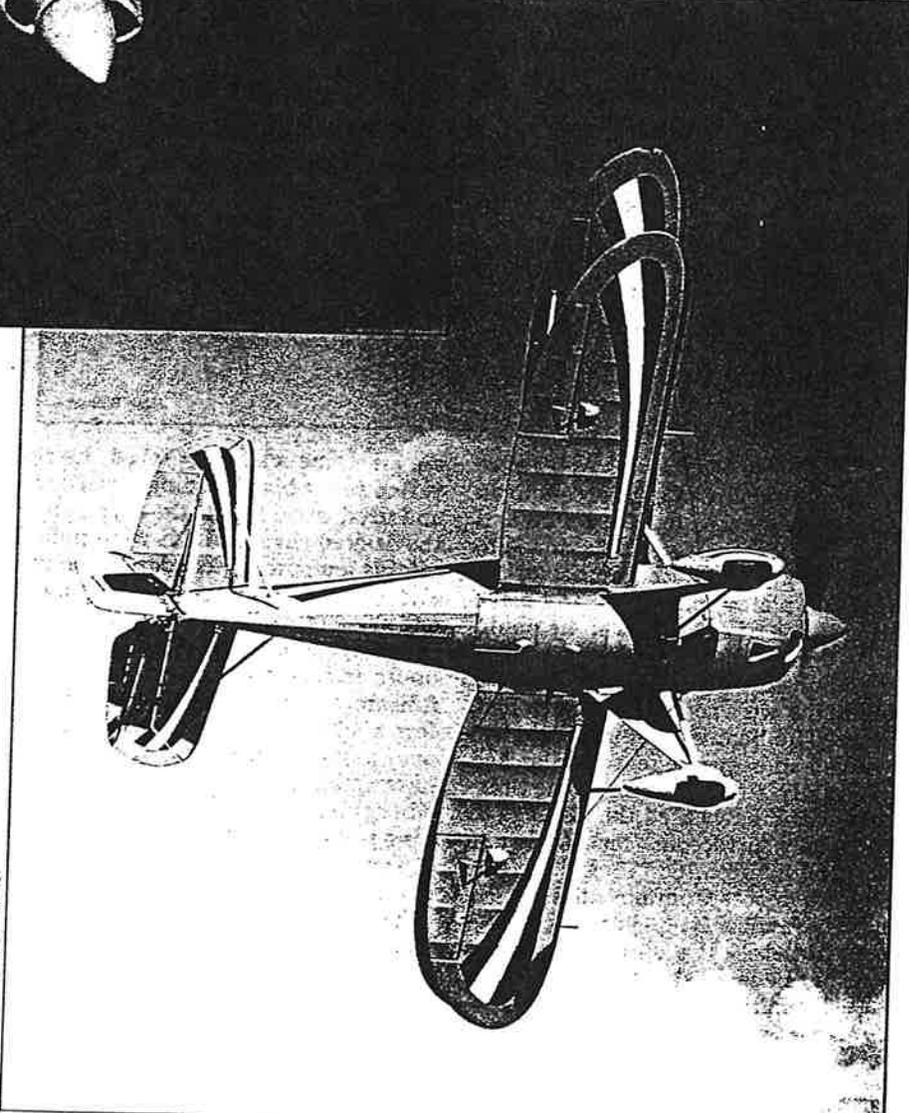
In the EAA world, biplanes will never go out of style . . . they'll just get better and more beautiful. ♦

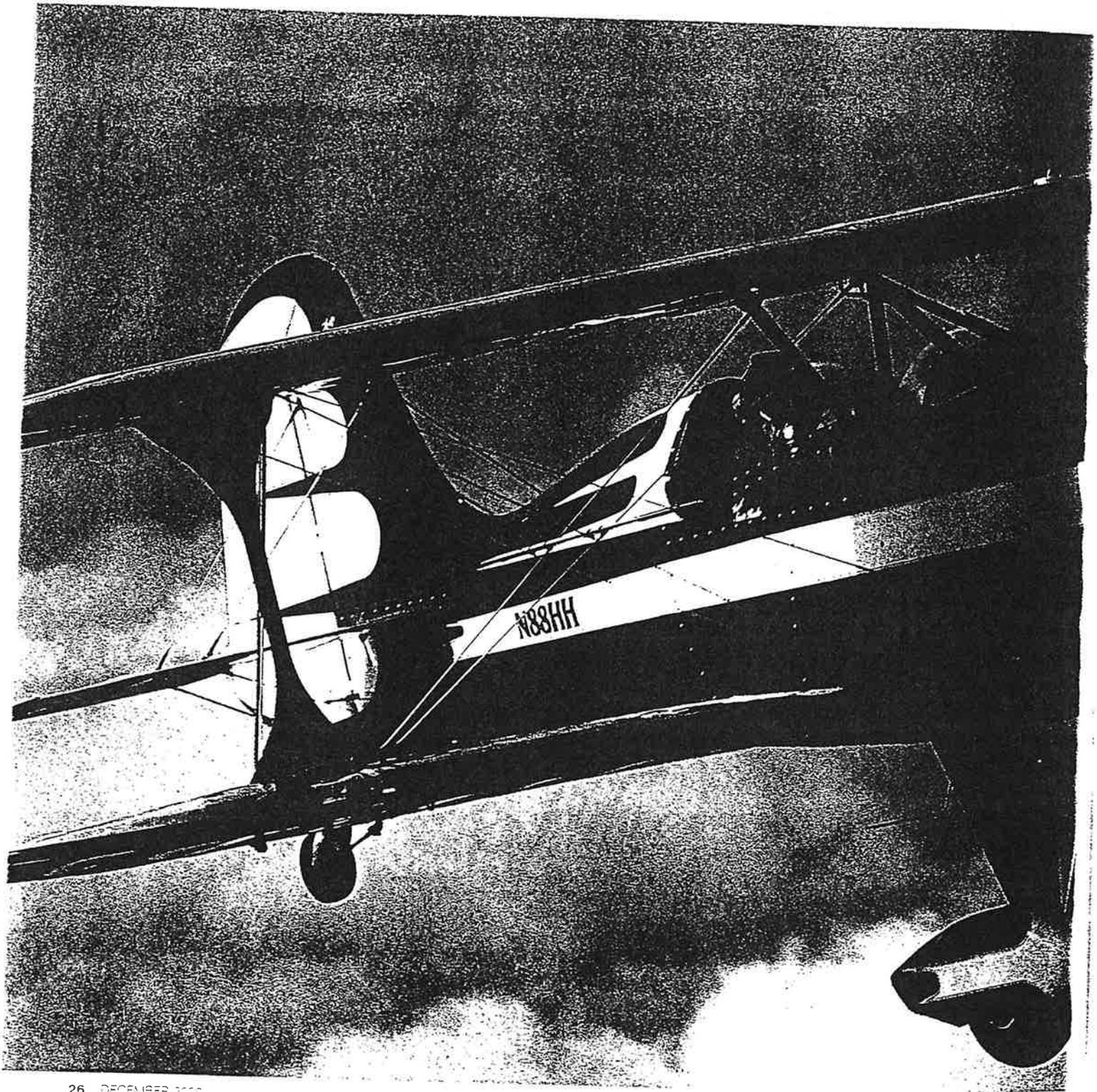
fitted with basic instrumentation, a KX-155 navcom, King transponder and Transcal encoder.

The airframe was covered with Poly Fiber (Stits) fabric and liquids. Gene made innumerable sketches during the construction period before finally coming up with the simple but colorful paint scheme you see pictured here. The principal criteria was that the design had to be all curves to match the airframe. "There are no straight lines in this airplane," Gene notes.

When completed last summer, N88H had an empty weight of 1,298 pounds, which Gene says he intends to reduce by about 40 pounds by removing the instrumentation in the front cockpit and refitting the Lycoming with a light-weight starter and alternator. The airplane will cruise at "well over 150 mph," providing the pilot wants to pour that much fuel through the engine. At 22/22, which is about 55%

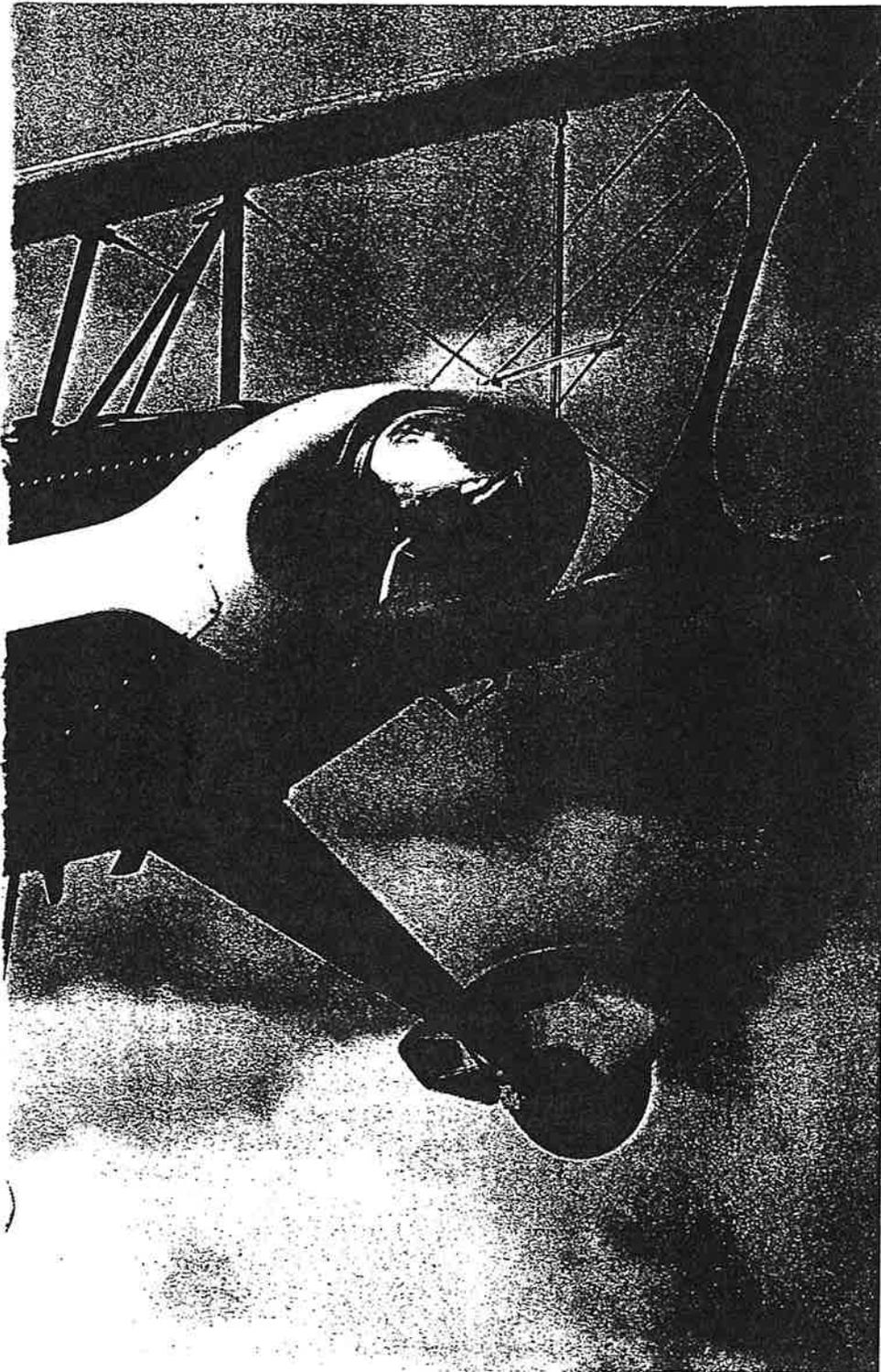
Mike Steineke





A Starduster Too rekindles Buck Rado's serial passion

JACK COX



When Róland "Buck" Rado was a young lad growing up in east Cleveland, he planned all his after-school activities around a daily 15-minute radio serial called *Hop Harrigan*.

"It was about a pilot and his mechanic," Buck fondly recalls, "and they would fly into jungles and other remote areas and have all sorts of adventures. Talk about imagination! I was right there in the cockpit with them, living all those hair-raising escapades. That's where so much of my interest in aviation came from. I really loved that program."

Buck's brother, Richard, shared his aviation interest, and together they built and flew models throughout their teenage years. Both also had their first flying lessons while quite young. "I was 16 when I took my first lesson. I'll never forget that. It cost \$5, and they even threw in the logbook. I couldn't afford to continue lessons and get my license, but the hook was set, and I knew that someday I would get around to it."

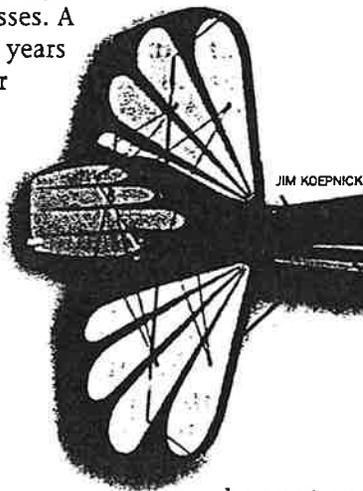
After high school, Buck got heavily into what we would call street rods today, customizing a series of late 1930s and early '40s Fords and Mercurys. It was through this activity that he learned to weld—the hard way. A neighbor loaned him his welding tanks and taught him how to properly adjust the torch, but the rest came through plain ol' trial and error.

"I didn't have any money to speak of, so I had to improvise. I

had to use an Electrolux vacuum cleaner in reverse to spray paint, and I used coat hangers for welding rods and things like that, but I learned a lot and got pretty good with a torch and a spray gun."

After high school, Buck went to work for Addressograph-Multigraph, got married in 1955, and became the proud father of two daughters and a son. After a time he was transferred to Mansfield, Ohio, where he built a dragster powered by a Mercury V-8 and invented a feed roll adjustment knob for Multilith and Multigraph duplicators.

Marketed as the Clik-trol, Buck sold them all over the world—until the Japanese copied the design and began installing it on all their offset printing presses. A few years later



he was transferred to Milwaukee, and aviation came back into his life in a rather unusual way.

"We lived in the Milwaukee suburb of Hales Corners, but it was a year or so before I learned about EAA and the presence of the museum there. I met Paul Poberezny one night after a Jaycee meeting, and that lit up the old aviation spark again. We later transferred to the Detroit area, where I went to work for a printing company. One day a neighbor showed me a copy of *Sport Aviation* that had the then-new Starduster Too on the cover. That was it—that was the beautiful airplane I had imagined flying when I was listening to the *Hop Harrigan* programs

when I was a kid. I knew right then that someday I would have a Starduster of my own."

Indeed Buck would buy the Starduster Too plans in the early 1970s, along with some steel tubing, and he actually began work on some airframe components, but family obligations and the financial demands the project would have placed on him to continue, put the Starduster Too on hold for a number of years.

Instead, he found a basket case Taylorcraft he could buy for a

song and restored it. That little taildragger would become a very special part of Buck's life—in a number of ways. Both he and his son, Scott, would get their private pilot certificates in it, and that experience would be the incentive that led his son to college and a career as a professional pilot. He would eventually become a captain, checkpilot, and simulator instructor for Simmons Airlines in Dallas—and no one would be prouder of his accomplishments

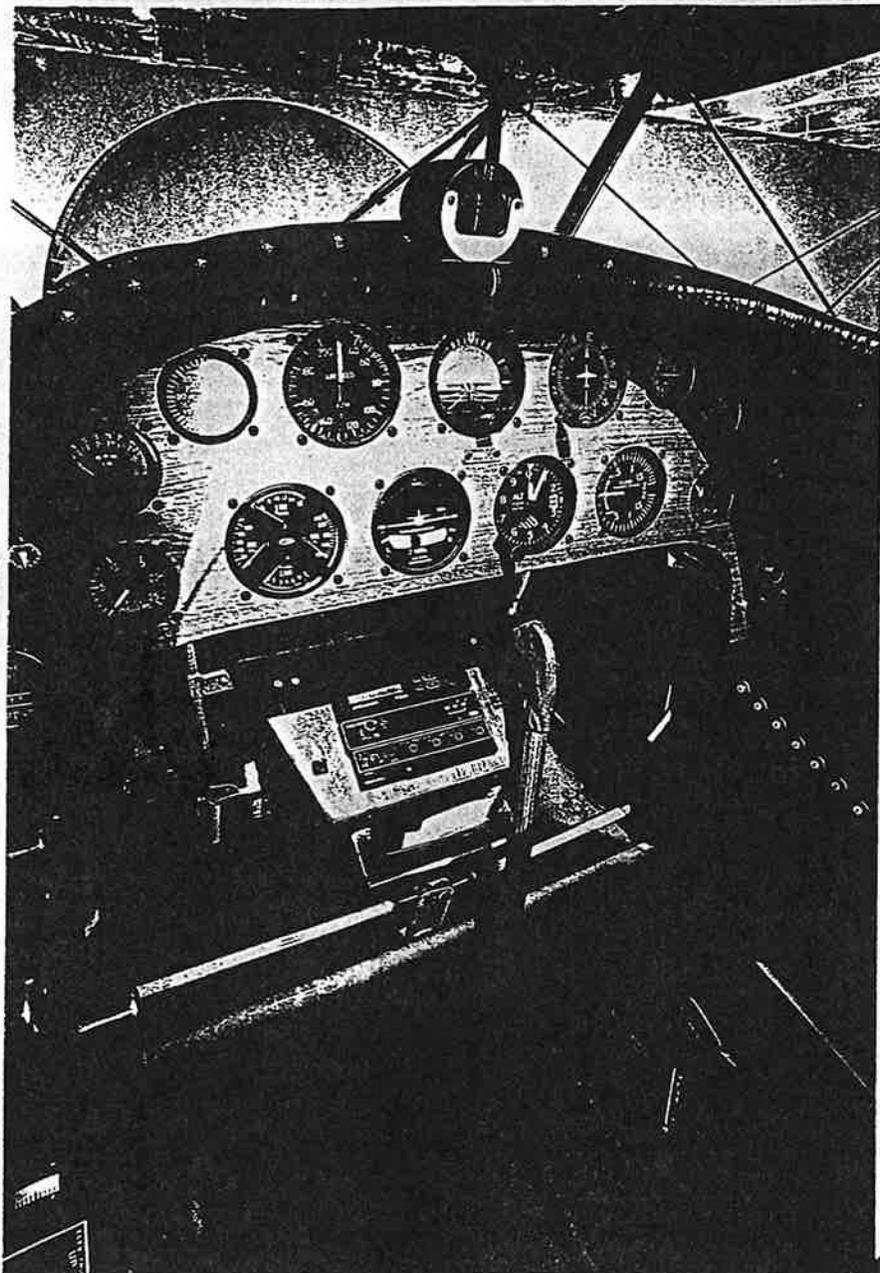
than his dad.

The Taylorcraft also put Buck back into the invention mode. For operations during bitterly cold Michigan winters, he designed his own simple, inexpensive propane engine preheater, and when fellow plane owners saw it, they began pleading for one of their own. Tooling up, Buck manufactured and sold copies of his little preheater, which he called "Hot Jugs," for several years. "Didn't get rich," he laughs today, "but I had a lot of fun selling them to pilots."

Back in the early 1970s, Buck's life had taken still another turn—one that would ultimately allow him to get back to work on his Starduster Too. In 1972 he had become a

teacher of modern printing at a Detroit-area vocational school, and that gave him after-hours access to all sorts of welding and metalworking tools and equipment. It also allowed him to introduce students to aviation and, particularly, high levels of craftsmanship. As in the case of EAA's Project Schoolflight programs, students developed a new sense of purpose and accomplishment when they realized that the part they were making would actually fly and that someone's life would depend on its integrity.

Buck retired in 1995 and began working full time on his Starduster Too. He had to sell his beloved Taylorcraft to complete the project, but



Standard VFR instruments are installed in both cockpits nestled in a mahogany veneer. A custom avionics box mounts below the instrument panel between his knees.

background as a custom car builder was bound to come to the fore at one time or another during the project. He had managed to buy a newly overhauled, 180-hp fuel-injected Lycoming IO-360-B1A and a Hartzell constant-speed propeller—and he just had to have the same sort of “sanitary” engine compartment he once had in his '39 Ford. That involved such cosmetic items as a burnished stainless steel firewall.

To create the burnish marks, or swirls, he made a tool 1 inch in diameter, glued a piece of leather to the bottom of it, and then mounted it on a Bridgeport so he could see the readout and move the metal exactly 1 inch at a time. Valve-grinding lapping compound was used to create the swirls, and the finishing touch was a careful polishing of the entire swirled surface. To keep such a jewel clean, he also installed an air/oil separator to keep his breather tube from slobbering oil and having it blown all over his handiwork.

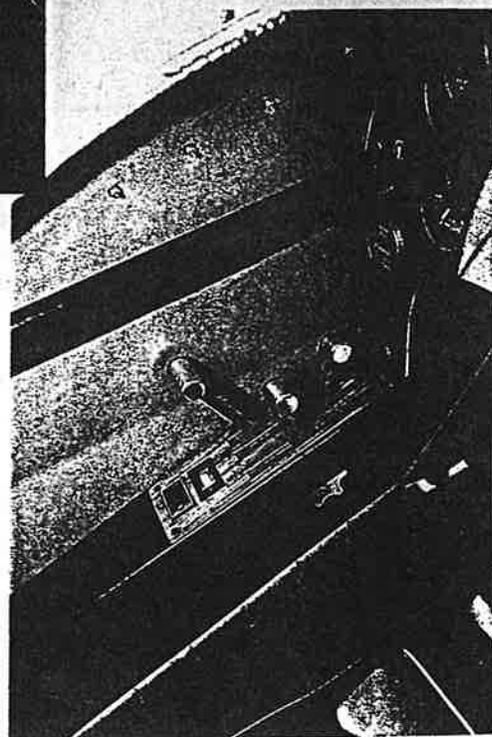
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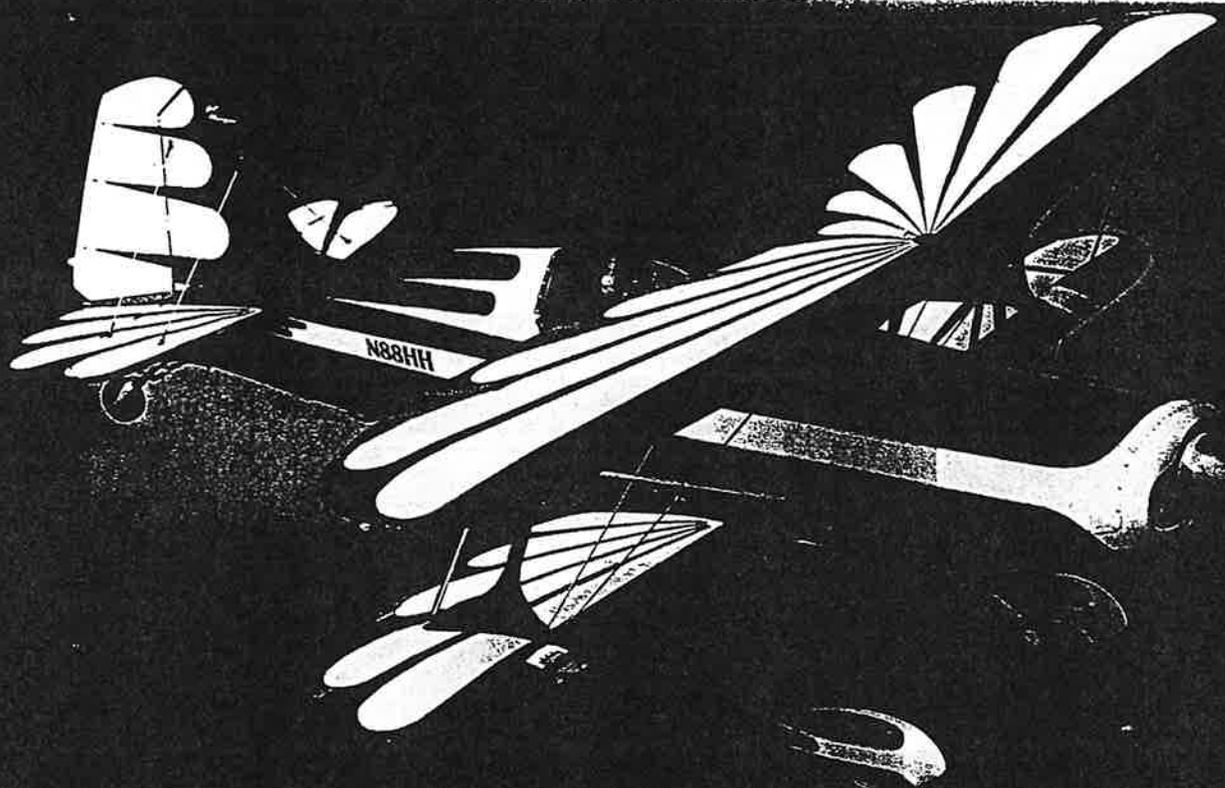
such was his commitment to owning his dream airplane. He completed the finish welding of his fuselage, tail feathers, landing gear, struts, etc. and built up the four all-wood wing panels and center section—and somehow found time to move during the process.

Buck started the airplane in Walled Lake, Michigan—the home, incidentally, of Williams International and the tiny jet engines that hold such promise of revolutionizing general aviation), and it moved with the Rados to Milford, Michigan, after Buck retired. It was in

Milford that the Starduster reached the cover stage. Buck used Poly-Fiber fabric, but he chose the Canadian Hipec finishing process out of concern for the effect Michigan's cold weather might have on his paint job. He'd read that the Hipec paint would remain flexible at extremely low temperatures, so he decided to use it to safeguard all the money and effort he would put into his cover job.

Although he stuck quite closely to the plans, Buck's





A modified turtledeck, custom fairings, and flush NACA inlets make Buck's Starduster unique, but it still has the same sensuous lines he fell in love with years ago.

One of the truly fun parts of the project, Buck says, was the wiring—and having it work the first time he turned on the master switch! Although he had no intentions of flying at night, he installed lights, at the insistence of his son, as an anti-collision consideration. He didn't install inverted fuel and oil systems because he is not interested in aerobatics. He simply wanted the Starduster because he thought it was so beautiful. Just getting to fly such an objet d'art was more than enough for him.

For the same aesthetic reason, Buck did not want any scoops protruding from his cowling, so he built flush NACA inlets instead, one for his oil cooler and another for his induction air. Likewise, he built a modified version of the standard Starduster turtledeck that did not taper down quite so much near the vertical tail. That area had always looked wrong to him, so he raised his a few inches. Buck also modified a number of fairings to better suit his eye and, he hoped, to reduce

“I was right there in the cockpit with them, living all those hair-raising escapades. That’s where so much of my interest in aviation came from. I really loved that program.”

drag a bit more.

He installed instrumentation in both cockpits, in panels overlaid with mahogany veneer. Buck made up his own avionics box, which was mounted below the instrument panel and between his legs, and installed a VAL radio, King transponder, and II Morrow Fly Buddy GPS—the standard sport aviation VFR array today, regardless of brand names.

Throughout the project, Buck had intended to install a canopy over his cockpits for winter flying, but he never saw an off-the-shelf version that fitted well, in his opinion. Finally, however, in 1994 he saw Gene Hudkins' highly customized Starduster Too on the cover of *Sport Aviation* and was so impressed with his canopy that he gave Gene a call at his home in Navarre, Florida. Pressed for details too hard to explain by phone, Gene invited Buck to visit him and see for himself. He did and got a lot more out of the visit than he bargained for—including a new home!

Sadly, Buck's wife had died by this point in his project, so when he found a beautiful home in the Florida countryside, with a 30-by-50-foot steel barn and enough acreage for an 1,800-foot airstrip, he bought it and moved south. The Starduster was ready for paint, but it would have to wait until Buck made a second move.

He quickly found the country home and acreage too far out and too time-consuming to maintain, so he sold it back to the original owner and had a new home built in Navarre Beach near his new friend, Gene Hudkins. Ironically, after a hurricane damaged his home, Gene would move in with Buck for a couple of months while repairs were underway—and it was during that stay that the canopy question was finally resolved.

Although he had always intended to install a canopy, Buck had really wanted open cockpits—because that was the airplane of his *Hop Harrigan* dreams. Gene sensed this during their many conversations regarding the Starduster, and one day he said, "Buck, you're living in Florida now, why don't you just leave the cockpits open and put on a couple of windshields?"

That was all the nudge Buck needed, and he has been grateful to Gene ever since. "I'm glad I did it. It just looks super with open cockpits—just the way I always thought a biplane should look"

Buck built a temporary paint booth in his garage and began the process of applying the red and white paint scheme that he had long since decided upon. "When I saw Jim Young's Starduster Too, 'Big Red,' on the cover of *Sport Aviation* back in 1975, I knew that was the



The Starduster is everything Roland "Buck" Rado saw in his *Hop Harrigan* dreams, and his N number honors the radio serial character.

way I wanted my airplane to look. I changed the trim just a little, mainly on the center section, but basically it's very similar."

Craftsman that he is, Buck would not have been content with just an ordinary paint job. Instead, his two colors and silver pin striping were all applied edge-to-edge—no overlapping. Clear coating completed the job.

When Buck applied for his N number, he asked for something ending with HH—for *Hop Harrigan*, of course—and the FAA gave him 88HH, which also gave it a kinship with Gene Hudkins' Grand Champion, N8HH. The numbers are vinyl and were designed by Buck's daughter, Leslie.

Throughout the long years of gestation, Buck's son, Scott, had always insisted upon making the first flight

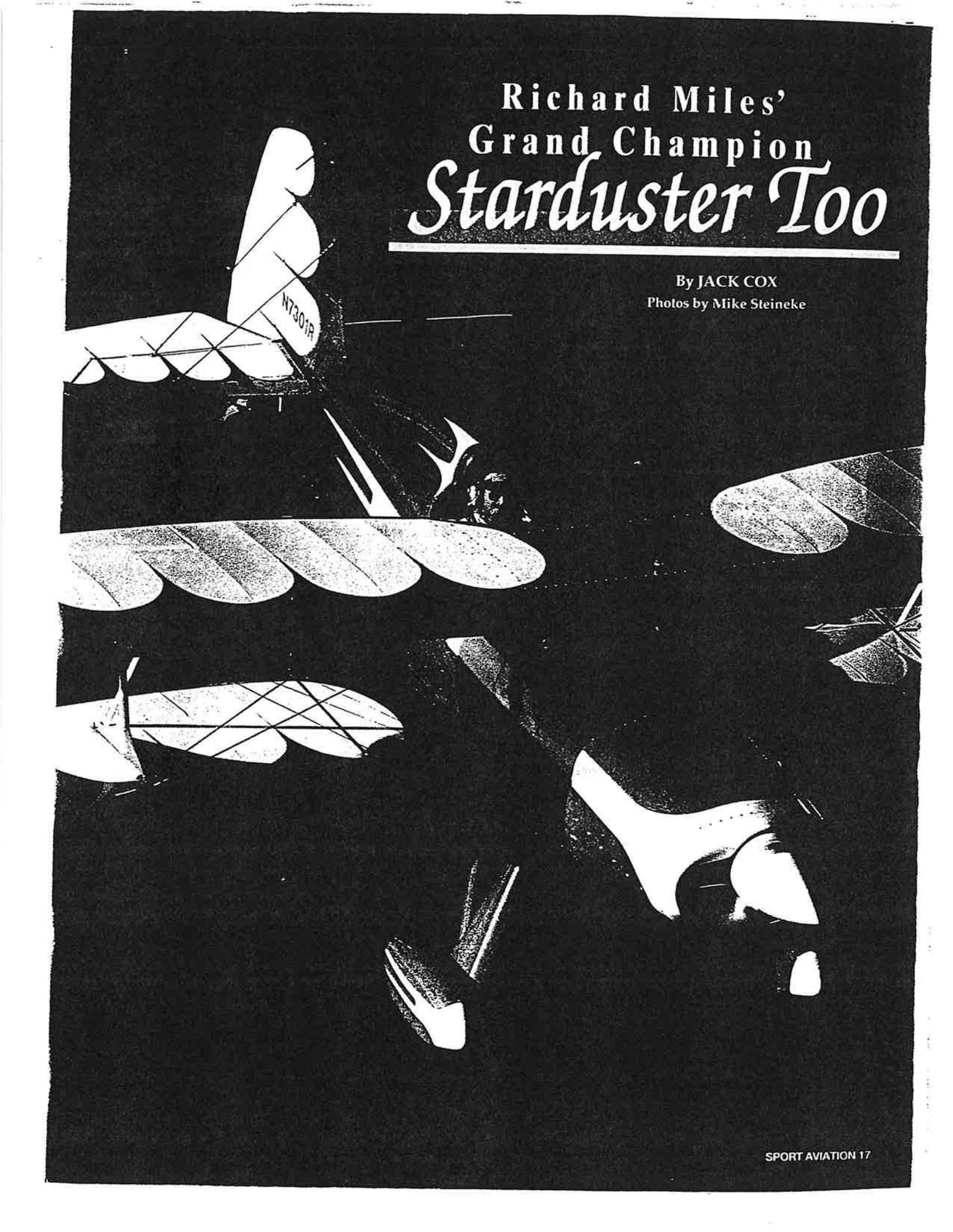
of his father's Starduster Too. "I really wanted him to do it, too, but as the time neared, I began to worry about it," Buck said. "Finally, one day I called his wife, Mary, and asked how she felt about it. I told her if she said no, I would understand and say no more about it. She said she knew how much it meant to both Scott and me and wanted him to do it, so that was that. She's such a wonderful lady. I still taxied the airplane for hours and checked and double-checked everything, just to be certain nothing was wrong."

The big day finally came on January 8, 1998. With perfect weather and with his daughter, Jodi, in from California for the occasion, Buck had the highly emotional pleasure of seeing his son fly his creation for the first time. "It was a day I'll never forget—a thrill that comes just once in a lifetime," Buck said.

At Sun 'n Fun 2000, Buck was extremely pleased to receive the Best Workmanship Award for his Starduster Too, but a recent encounter at his hangar at Milton, Florida, seems to have more closely reflected his own feelings toward N88 *Hop Harrigan*.

"One day a man drove by my hangar, which was open, then stopped, and backed up for another look. He got out, walked in, and stood looking at my Starduster, but he said nothing. I said, 'Hi, how're you doin', but there was no answer. Thinking he didn't hear me, I said, 'Hi,' again, but still no answer. His back was to me, and there was complete silence for some time, but, finally, he said, 'I know you're talking to me, but I can't take my eyes off your airplane. It's absolutely beautiful!'"

EAA



Richard Miles'
Grand Champion
Starduster Too

By JACK COX
Photos by Mike Steineke

The Grand Champion (Plans) Home-built at Sun 'n Fun '93 was a beautiful 300 hp Starduster Too built by Richard Miles of Rome, Georgia . . . and EAA Chapter 709.

Eighteen years ago, in 1975, the homebuilt Grand Champion at Oshkosh was a magnificent 300 hp Starduster Too built by Dr. Jim Young of Culver City, CA. Named "Big Red," it was built strictly as a showplane with fully upholstered cockpits, IFR instrumentation, stereo music over the intercom and much, much more. Big Red was on the cover of the October 1975 issue of *Sport Aviation* and made a tremendous impression on biplane lovers the world over because rarely had that much luxury and power been stuffed into an open cockpit sport-plane before. Sadly, in 1980 Jim Young would get caught in bad weather in the mountains north of Los Angeles and would die in the crash of his single place aerobatic biplane, the Sunbird . . . doubly sad because he would never know how widespread and how far into the future his influence would reach.

One of the persons who heard bells go off when he first laid eyes on the October 1975 issue was a 23 year old from Marietta, Georgia named Richard Miles.

"When I saw that airplane in my dad's *Sport Aviation*, I said, 'That's for me!' I still have that very magazine on my shelf at home and I've read the article many times over the years. Big Red was my inspiration."

Richard grew up with tools and mechanical projects. He and his father, Richard, Sr., built "choppers" (custom motorcycles), dune buggies and race cars throughout his childhood and teenage years and won a lot of trophies with them at custom auto and motorcycle shows. His father was also a pilot and owned at one time or another a Decathlon, Cessna 150 taildragger conversion and a Maule. Perhaps it was inevitable that a homebuilt project would eventually turn up in the Miles workshop, and it did . . . a Cassutt racer and, later, one of Graham Lee's 7/8 scale Nieuports, but someone always came along and bought them before they could be completed and flown. It was during the construction of the Cassutt in the late '60s that Richard became hopelessly infected by the flying bug, but it would be a long time before he would get around to his own project . . . or even learning to fly.

After high school came a draft notice from Uncle Sam and a hitch in the Air Force as a ground radio equipment repairman . . . then college at Southern Tech in Marietta where he started out in a mechanical course, but later

switched to surveying. It was also during his college years that he was introduced to his future wife, Jackie . . . and, perhaps predictably, he showed up for their first date on one of his prize winning choppers.

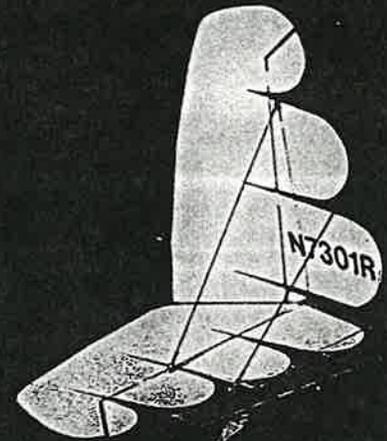
Roughly the next decade and a half were spent getting established as a family man and a businessman. Richard and Jackie were married, they had a daughter, Mindi, now 16, they built their own home in Jackie's hometown of Rome, GA and Richard started his own surveying company, specializing in civil projects such as highways, shopping centers and airports. He continued to build custom cars and motorcycles as a hobby, but ever so often he would pull out that October 1975 issue of *Sport Aviation* and reread the article on Big Red. In his mind, that was the ultimate project, so no matter what else he built and no matter how well it turned out . . . and he is the consummate perfectionist, Jackie says . . . he could never be totally satisfied because this greater challenge was still out there and yet to be attempted.

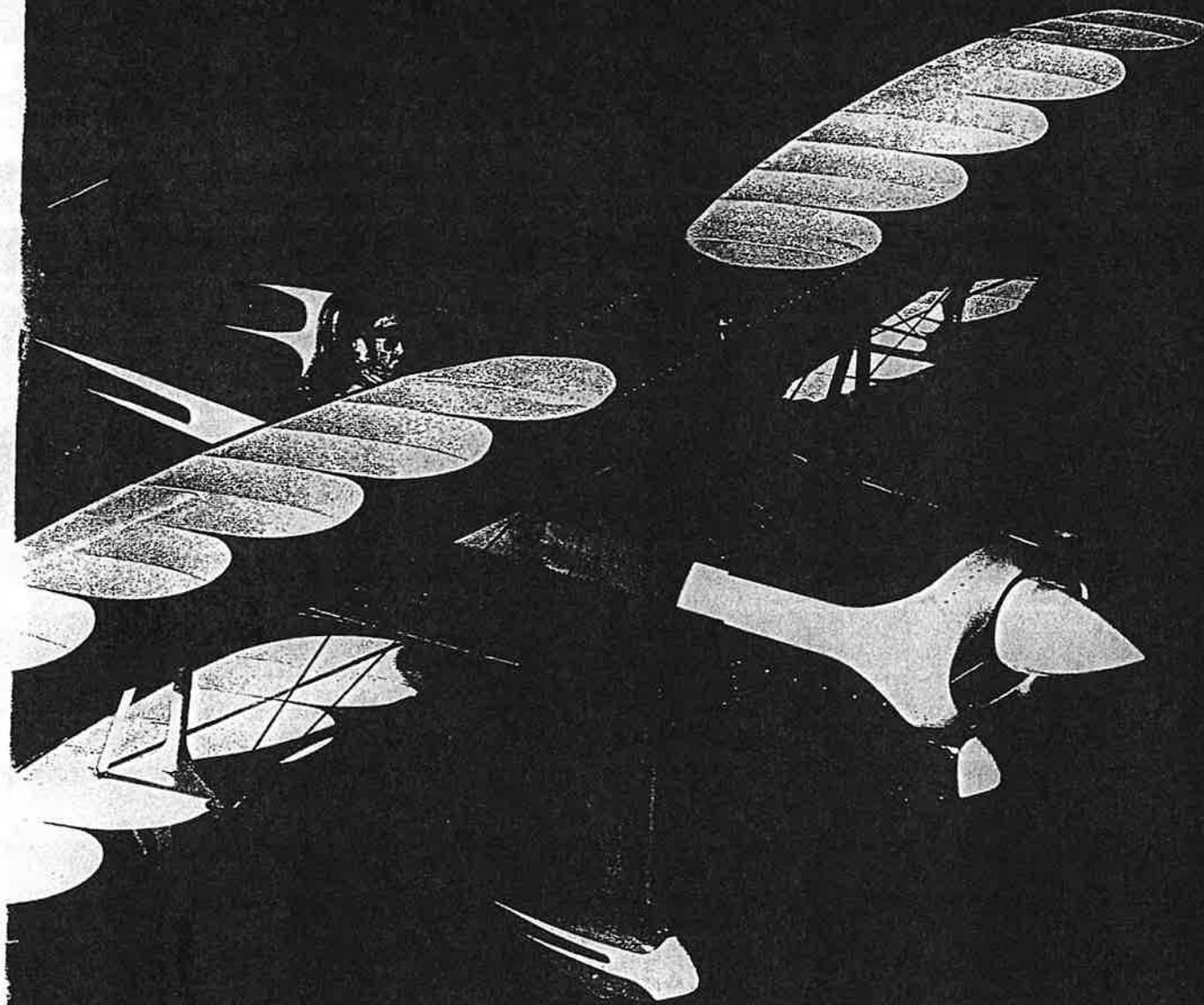
Finally, in the late 1980's he simply couldn't stand it any longer and made the decision to build his own version of Big Red. For most people this would have meant buying the plans, stocking up on materials and plunging into the project as quickly as possible. Richard is cut from a different cloth, however. His modus operandi is to begin by thinking through a project down to the most minute detail; then he assembles all the tools, equipment and materials; and, finally, he actually starts to work . . . with a minimum of wasted time and effort.

The first order of business was to construct a workshop, a 36' x 48' shop with built-in jig tables sized for the largest components of a Starduster Too, a paint booth, and, obviously, room to fully assemble the airplane in its final stages of construction. This endeavor took a full year, but it paid off. His Starduster Too plans arrived in Rome on January 12, 1988 . . . and he had the fuselage sides laid out on the jig table by the next afternoon and was ready to begin cutting tubing.

The goals of the project were twofold: Richard wanted to build the airplane of his dreams, of course, with all the custom touches he had read about that had been incorporated in Big Red, plus a lot more of his own that came to mind as a result of his years of building custom cars and motorcycles; and he wanted to do it all himself. Building was not simply the means to an end; he enjoyed the process and intended from the start to do it his way no matter how long it took. He did purchase a few items from the Stolp

Starduster Corporation, such as the distinctively shaped Starduster fiberglass turtle deck, nose bowl and wheel pants. He also had Starduster's Bill Clouse weld up the center section and fuselage fuel tanks (44.5 gallons total), and was fortunate enough to come across a Starduster wing material kit in Trade-A-Plane for about one-third the retail price . . . located only about 70 miles from his home! Further, he was able to buy a 300 hp Continental IO-520D and a 3-blade McCauley constant speed prop, both of which had recently been overhauled, right off the nose of a





Bellanca Super Viking. Except for the obvious things like avionics, 6:00 x 6 Cleveland wheels and brakes, 3200 Scott tail wheel, lights and such, Richard built everything himself.

As might be expected of someone so methodical, Richard built jigs for everything, partly so he could build almost every part and subassembly without need of an extra set of hands and partly so each would be as dimensionally accurate as he could possibly make it. He did all his own welding and machining and when the metal parts were completed, they were cad plated and

painted with Stits (Poly Fiber) epoxy zinc chromate. The components that were too large for cad plating, such as the fuselage frame and tail surfaces, were sandblasted and zinc chromated. All the parts of the fuselage and tail surfaces that would not ultimately have fabric glued to them were painted with white aerothane

"It took only about a month to weld up the fuselage, and at that point, I thought, 'Man, I'm half through... all I need to do is build the wings and I'll practically be finished!'"

Five years later he would be fin-

ished, but he had received quite an education in the meantime.

"My memories of the Cassutt project back in the '60s were probably the source of my misplaced optimism. I found out in a hurry that a biplane the size of a Starduster Too was something entirely different. It wasn't a lot more difficult, there were just so many more parts and subassemblies to make."

The wing kit was basically raw material, with the exception of the plywood ribs which had been cut to shape. Richard built the wings and center section and finished all the wood



Richard Miles and his Starduster Too. Richard is the current vice president and a Technical Counselor of EAA Chapter 709 in Rome, GA.

with 4 coats of Stits epoxy varnish to completely waterproof them . . . and as is commonly the case when a real craftsman works his magic on wood structures, all his friends and fellow EAA Chapter 709 members bemoaned the fact that he would have to eventually cover all his artistry with fabric.

During the five years it took to build the airplane, there were several plans revisions issued by Stolp Starduster, and Richard incorporated all of them. One, a change in the aileron slave struts, was quite a project in itself, involving new bellcranks, brackets and linkages. Unfortunately, the original parts had already been built, so all he could do was hang them on the shop wall as conversation pieces and start over from scratch. Another change was in the mounting of the main gear. In their original location, the mains were too far forward for the four cylinder Stardusters, which put as much as

150 pounds on the tailwheels of some of them, Richard says. The situation was not as critical with the big six cylinder Continental up front, but he moved the gear back as advised anyway. When completed, there would be about 60 pounds on his tailwheel.

Richard made up all the sheet metal parts for the airplane, which, again, turned out to be quite an education. He wanted to keep the front end of the fuselage as clean as possible, so he recessed his fuel and oil filler pipes and built flush access doors for them. A lot of time and effort went into making an easily removable metal cover for the front cockpit . . . and he thought: he would never finish the landing gear leg fairings. The distinctive large-at-the-bottom, small-at-the-top gear leg fairings are Starduster trademarks, so he wanted them to be exactly the right shape . . . so much so that he built half a dozen sets before he was satisfied!

Despite all his previous car and motorcycle work, Richard had never attempted to hand form compound curves in aluminum.

"I've got a whole pile of fairings lying around my shop that just didn't work out. What I didn't realize in the beginning was that just the least little bit of heat generated by a sander was tempering the aluminum. When I finally figured that out, I began to turn out some acceptable work . . . but I was never satisfied with the fairings I made for the bottoms of the windcreens. I ended up making those out of fiberglass. One of the most difficult parts of the sheet metal work, however, was making the top piece where all the cabane struts and wires come out through it. I made several cardboard patterns before I finally got the fit I was looking for."

With the basic structure done and all the sheet metal aft of the firewall com-

pleted, Richard tackled the engine installation . . . which turned out to be one of the easier tasks.

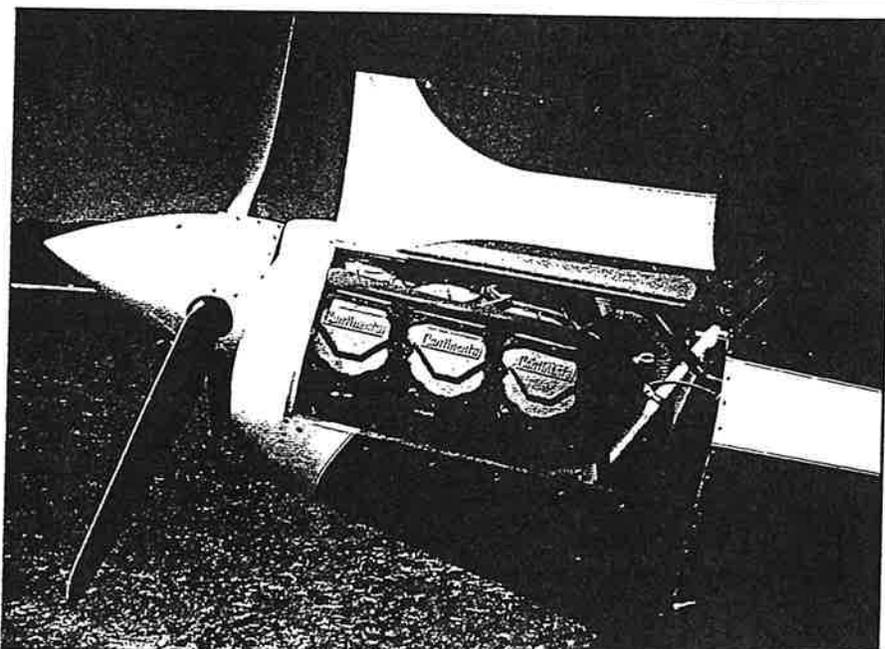
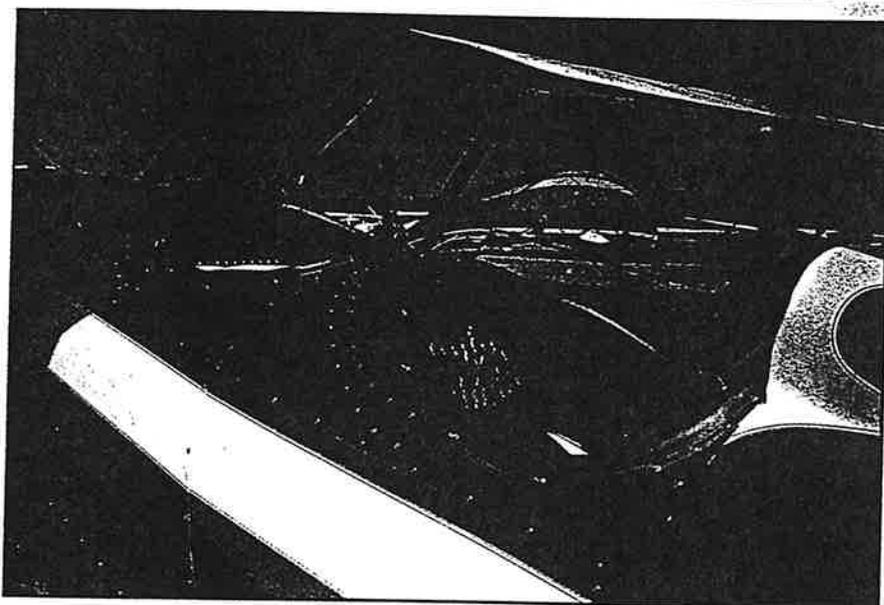
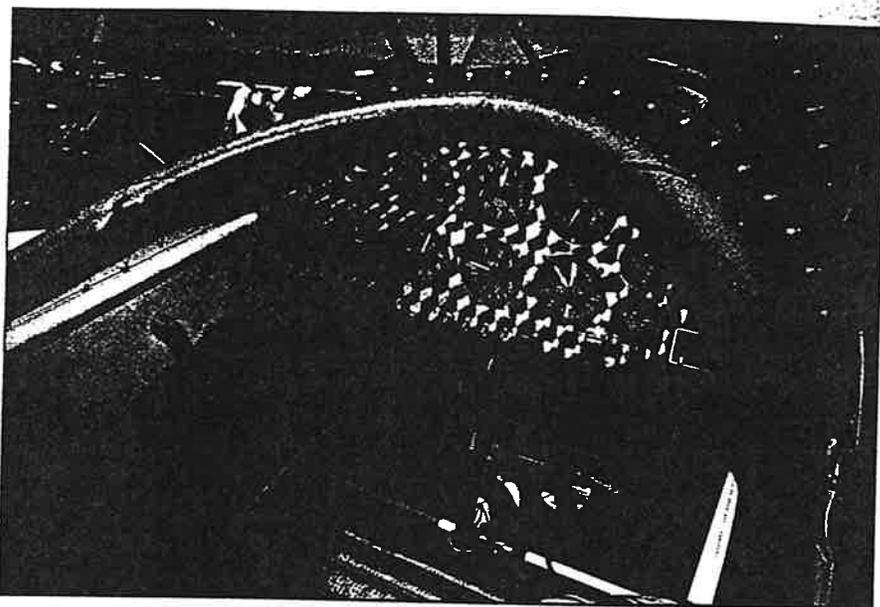
"It really didn't involve a lot more than just bolting it in and wiring and plumbing it. I used a straight exhaust system and had to make up new baffling to fit inside the Starduster cowling, but that was about it."

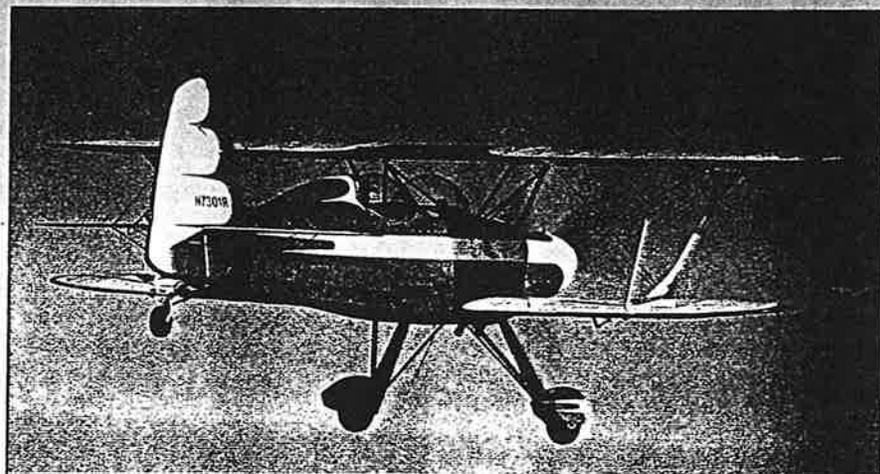
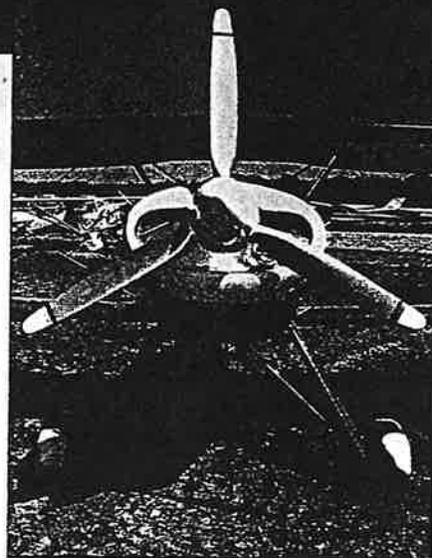
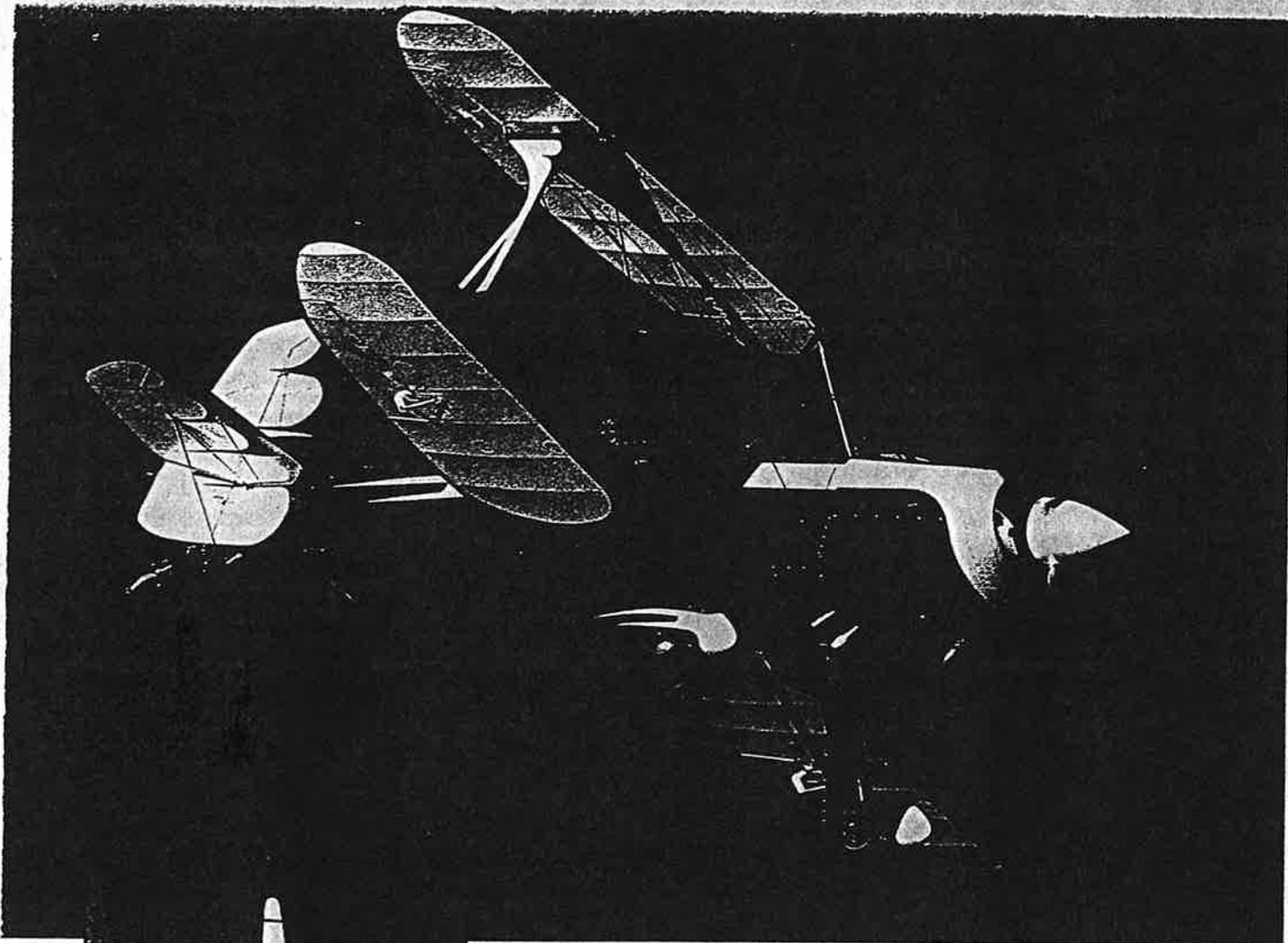
He did install an inverted fuel system and had purchased a Christen inverted oil system, but did not have time to install it before his trip to Sun 'n Fun '93.

Once he got into the cockpits, the real fun began for Richard . . . in more ways than one. This was where the customizing would really begin and that was what he enjoyed most. Also, to this point, which was about two years into the project, he was still not a pilot. Sitting in the cockpit and imagining himself flying, he realized he did not know where things other than the basic stick, rudder pedals and throttle were supposed to go . . . so, this was the time, he decided, to get himself out to the airport and learn to fly. He took his training in the customary Cessna 150 and Piper Warrior and earned his Private license . . . but still had not set foot or fanny in a mean ol' taildragger.

The Starduster plans, concerned with keeping weight to a minimum, call for plywood floorboards just large enough for one's feet. Richard had practiced weight control up to this point, but now it was time to get fancy! He completely lined his cockpit area, front and back, in sheet aluminum . . . full aluminum floorboards, sidewalls and forward and aft close-off bulkheads. Built into the sidewalls were generous armrests, with the right one in the rear cockpit containing the electrical panel and the mixture control . . . and the left mounting the custom throttle quadrant Richard built himself.

The rear cockpit's instrument panel ended up being machine turned, but only after being painted several times without a satisfactory result. Richard uses a lettering machine in his surveying business, and was able to slip the flat panel in it and label all the knobs and switches the FAA wants identified. Although he is not instrument rated, Richard wanted to have an IFR certified panel in the rear cockpit, and proceeded to stuff in all the avionics and gyro instruments that are required, along with a full array of engine monitoring instruments. He also wanted to fly the airplane year round, so he built in ducting to deliver hot air to both cockpits. He first tried an adjustable automotive plastic vent in each 'pit, but they began to melt the first time they were used and had to be replaced with metal. The big Continental supplies a





lot of heat, but with the front cockpit open, most of it blows out to warm half of North Georgia. With the cover on, the rear 'pit is comfortable down to an ambient temperature of about 29 degrees Fahrenheit, which takes care of most of Georgia's day-time "winter" weather. (That would be comfortable for about two and a half months of Wisconsin's "summer," from, say, 1:30 to 3:30 p.m. in the afternoon . . . on

sunny days, of course.)

A lot of cutting and fitting of foam went on before Richard was comfortable for extended periods in his seats, but, finally, he was ready to start installing the upholstery. He made patterns and cut the silver (light gray) colored material, but took it to a professional to sew. Both cockpits were fully upholstered, top to bottom.

The airplane spent a lot of time sit-

ting fully rigged in Richard's shop . . . held together with baling wire. It took 23 weeks from the time the Macwhyte flying wires were ordered until they finally arrived in Georgia. One possible hold up was the fact that he ordered four custom wires to replace the struts that are commonly used under the horizontal tail. He figured the wires would be lighter and would produce less drag than the struts, but, mainly, he just did

not like the looks of the struts. Broom handles are commonly used as javelins to tie together the wing wires where they cross at mid span of the wings, but, of course, that wasn't good enough for Richard. He machined his out of 6061 T6 aluminum and polished them until they looked like solid chrome. He also made up his own pitot tube in a similar fashion.

The airplane's rudder pedals have a Starduster logo on them, and most observers assume they were supplied by the Stolp Starduster Corporation. Actually they are Maule pedals, bought new from the factory, with the Maule name milled off. Richard had a trophy shop make up the Starduster logos to attach to them.

The very last thing built for the airframe was the landing light, which is mounted in the front engine baffle just to the left of the prop spinner. Richard searched high and low for a mounting frame for the light and found nothing to his liking . . . until one day he noticed that a 4 inch PVC drain pipe elbow had a flare that looked like it would fit the lamp perfectly. Sure enough it did, so the flange was cut off . . . and now it serves a far more noble purpose than it ever did before.

The last big job was covering the airplane and Stits (Poly Fiber) materi-

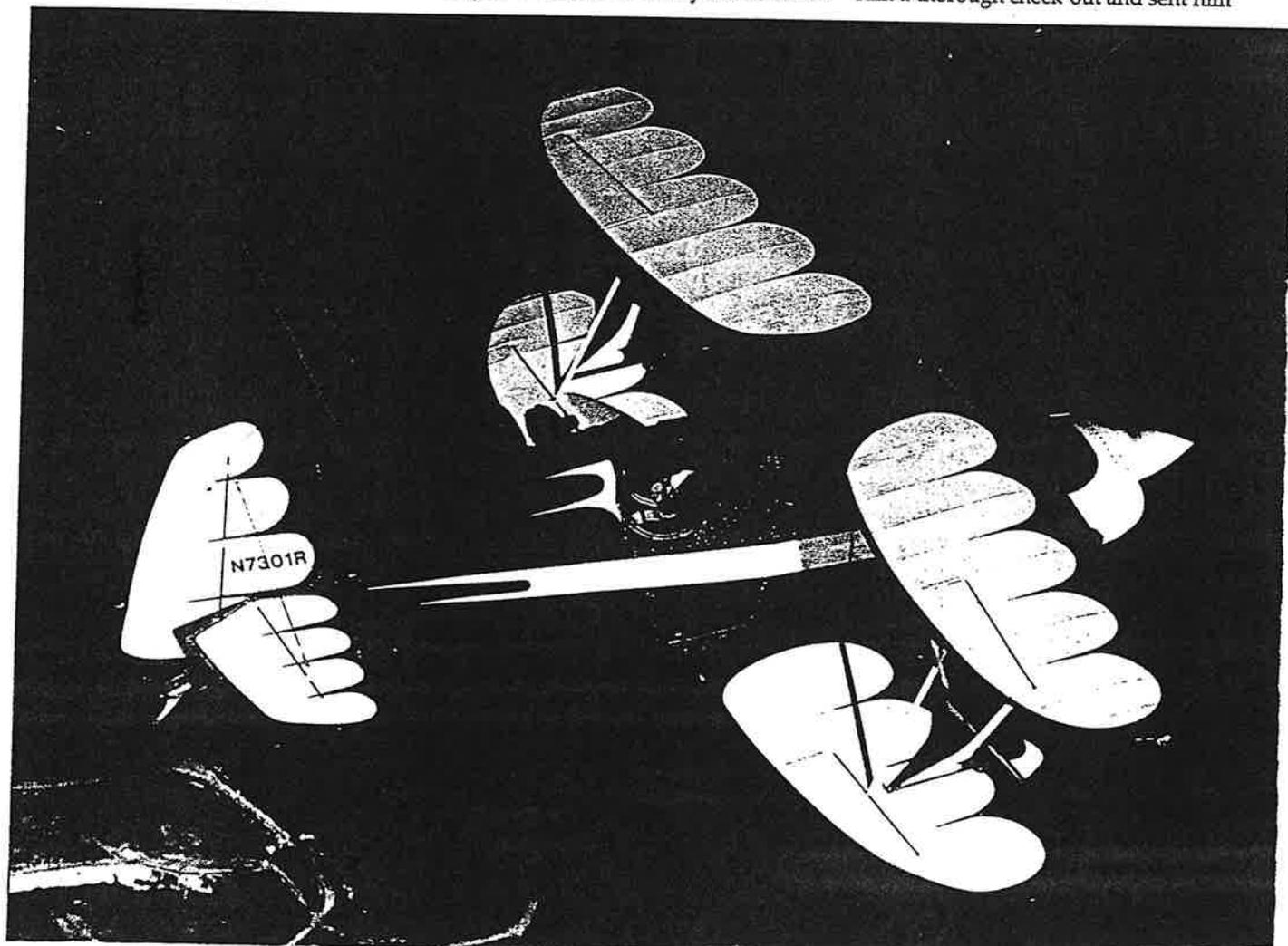
als were used from start to finish. There never had been any question about the choice of colors, of course . . . it was going to be red with white trim. To make the red really glow, the airframe was painted entirely in white and then the red was applied over it. All the spraying was done in Richard's well-ventilated paint booth and he personally used a double cartridge respirator. In all, 17 coats of paint were applied, most of which was sanded off with 600 grit paper between coats. The trim scheme is much like Big Red's, but has some variations Richard incorporated when he masked the airplane for the application of the red. Initially, blue pin striping was applied, but after looking at it for a couple of days, he decided he didn't like it and pulled the tapes off. Jackie suggested silver pin striping to match the silver upholstery and that has turned out to be the favored choice.

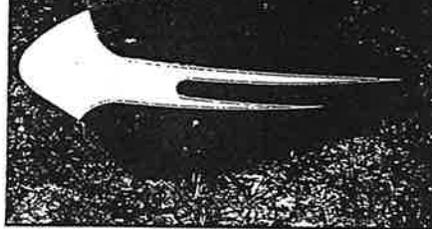
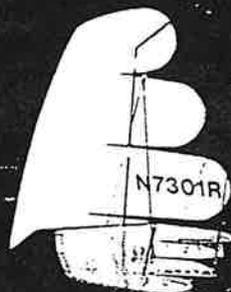
The Starduster was finally finished and taken to the Rome airport in August of 1992 for assembly and flight testing. Richard says that the biggest surprise of the entire project was the time it took to put the airplane together, rig it, work out all the little bugs that showed up in engine runups and taxi testing and get it ready for its first flight. He never had any intention of

making the first flight himself, but he did get CFI Brett Cookston to give him 10 hours in a Citabria to prepare him for the day he would fly the Starduster.

First flight honors had been reserved for his friend Bobby Allred, a 14,000 hour pilot with a lot of time in ag planes and other taildraggers. The big day finally arrived on November 8, and after some high speed taxi runs, each progressively faster, Bobby finally blasted off . . . and totally blew everyone on the airport away with the airplane's awesome rate of climb! Richard freely admits that one of his best decisions during the entire project was letting Bobby make the initial flight, because his emotions were such that he doubts he would have known the stick from throttle had he attempted it himself. It was one of the biggest thrills of his life to see his creation thunder off into the blue, matching even his own subsequent first solo in the airplane. All those years in the shop, all those times he had looked longingly at Big Red on the cover of *Sport Aviation*, every heartache and every triumph flashed before his mind's eye as it lifted off.

The FAA test time was flown off in fairly short order, considering it was winter already, and Richard finally did get his turn in the rear 'pit. Bobby gave him a thorough check-out and sent him





off on his own. Significantly, Richard had only about 100 hours total time when he soloed his 300 hp, hairy chested fire breather, only 15 or so of which had been in a taildragger. The fact that he was able to master the airplane with relative ease . . . on pavement . . . is a positive commentary on both his piloting abilities and the fact that he built a straight airplane. A lot of ground handling problems are caused by misaligned gears and improper toe-in (or out), but Richard says his Starduster shows no propensity for darting for the toolies. In the air, it flew hands off from the start . . . all of which tells us the elaborate jiggling he

did during the construction phase paid off with a fine handling airplane.

So, what were the bottom lines? First, N7301R came out with an empty weight of 1,445 pounds. This seems heavy for a Starduster Too until you consider that a Continental IO-520 and a 3-blade McCauley propeller has an installed weight of over 500 pounds. He felt a lot better when he dug back into his old copy of *Sport Aviation* and found that Jim Young's Big Red had an empty weight of 1,580 pounds! In any case, the CG was right in the middle of the envelope . . . and with all that horsepower up front, the airplane was certainly not lacking in performance. Initial acceleration is terrific, Richard says, and the big bird gets off in 400 to 500 feet. At 120 mph it will climb at nearly 4,000 fpm initially and keeps going up at an impressive rate . . . as our Turbo Centurion photo pilot, Bruce Moore, found out when he attempted to stay with it when the photos accompanying this article were taken. The Cessna was left panting in the Starduster's wake. When asked about cruise speed, Richard says it depends on how much money he wants to spend. At 50% power he sees 135 mph indicated at 11 gallons per hour. If he's

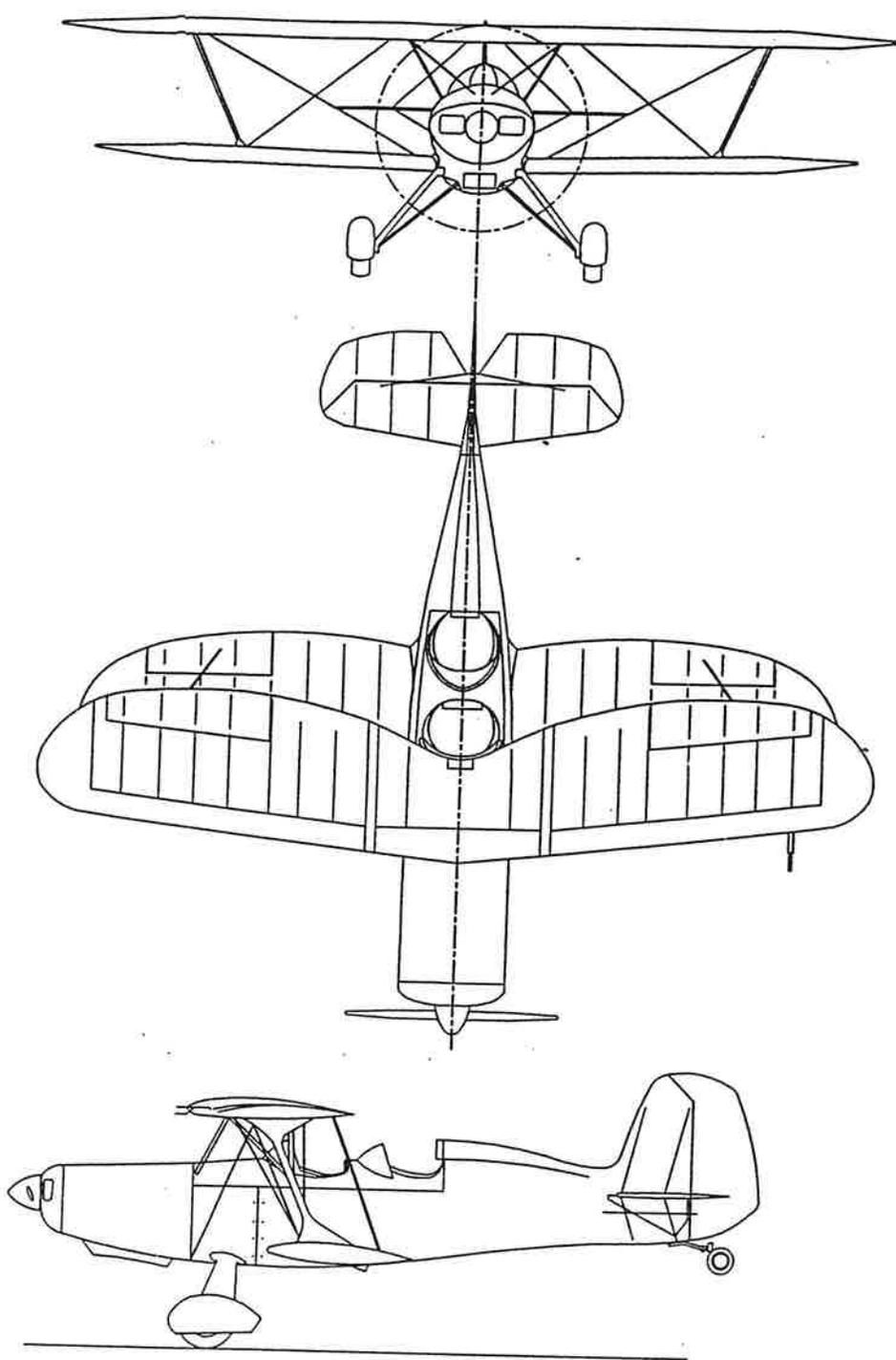
feeling extravagant on a given day, he can push the Continental up to 75% and see 170 mph indicated . . . at 20 gallons per hour.

"Knowing that's about \$40 per hour just for fuel kinda takes the fun out of it, so I do most of my cruising at 50%," he says.

At Sun 'n Fun in April he had never run the airplane wide open in straight and level flight so he didn't know what his top speed was . . . and didn't particularly care. It was fast enough for him at 75%.

From the moment Richard landed at Lakeland, his Starduster was a sensation. Everyone loves a beautiful open cockpit biplane and this one certainly had hearts aflutter. Late in the week, Jackie and Mindi drove to Lakeland and were at the awards ceremony on Saturday night to hear Richard's name called to accept the Grand Champion trophy for plans-built homebuilts. It was quite a thrill for the entire family and quite a reward for all the work Richard put into the project. The greatest reward, however, will always be the Starduster, itself . . . about which he had the last word:

"This is every dream of an airplane I ever had." ◆



THE STARDUSTER TOO WAS BUILT TO FILL A NEED FOR A REASONABLY SIZED TWO PLACE
 SPORT BIPLANE. IT WAS BUILT TO FLY JUST FOR FUN AND IS NOT INTENDED TO BE
 AEROBATIC MACHINE. IT IS QUITE STRONG, HOWEVER, AND STABILITY IS GOOD. THE
 WING LOADING MAKES SLOW LANDING SPEED SHORT FIELD OPERATION VERY GOOD.
 FUSELAGE, TAIL, LANDING GEAR, ENGINE MOUNT, STRUTS, ETC. ARE MADE OF WELDED
 STEEL TUBING. THE WINGS HAVE SPRUCE SPARS WITH RIBS MADE OF 1/4" PLYWOOD.
 CONSTRUCTION OF THE PLANE HAS BEEN KEPT AS SIMPLE AS POSSIBLE AND IT GOES TOGETHER
 VERY WELL. THE DRAWINGS FOR THIS PLANE ARE PRINTED ON AN OFFSET PRESS SO THEY
 DO NOT FADE OR SHRINK. THE PRINTS ARE VERY COMPLETE WITH RIBS AND MOST FITTINGS
 ARE THE SAME SIZE WHICH SAVES CONSIDERABLE TIME ON CONSTRUCTION OF THESE PARTS. THESE
 PLANS HAVE BEEN CONSTRUCTED WITH ENGINES RANGING FROM 145 TO 260 HP, HOWEVER,
 THE 180 HP VERSION IS THE ONLY ONE SHOWN IN THE DRAWINGS. RAW MATERIALS SUCH AS
 STEEL TUBING AND SHEET, PLYWOOD, HARDWARE, AS WELL AS FUEL TANKS, NOSE COWL, WIND-
 SHIELDS, WHEEL PANTS, ETC. ARE IN STOCK AND AVAILABLE AT ALL TIMES. THE SA300 IS
 NOT A SMALL AIRPLANE BUT BY NO MEANS A LITTLE ONE. IT IS LARGE ENOUGH TO DO THE JOB
 INTENDED OF IT. IT IS EASY AND FUN TO FLY. THE PLANE HANDLES WELL ON THE GROUND
 AS WELL AS IN THE AIR.

THE STARDUSTER TOO IS A FINE BIRD AND A JOY TO OWN.

YOU

Plans Ordering Information

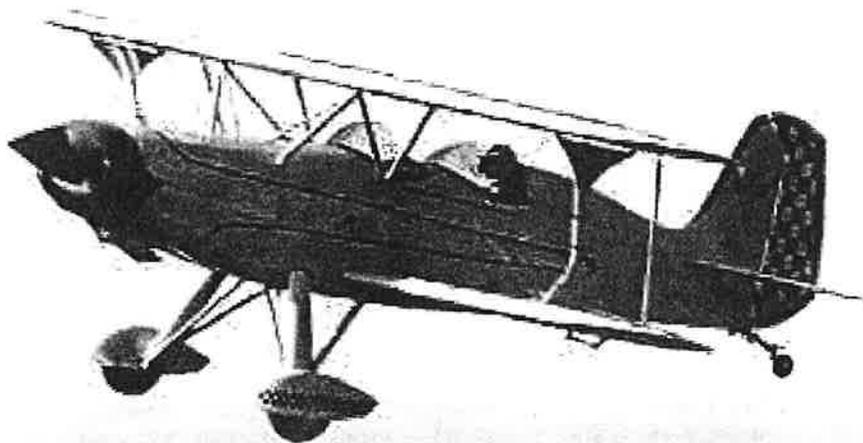
Thanks for your interest in the Starduster Too Aircraft. We hope this information helped you on your quest for information on the SA300.

If you wish to order the plans please fill out the license agreement on the following page. When it is filled out and signed, send it in to Aircraft Spruce West, 225 Airport Circle, Corona, CA 92880, attn: Renee Gelinias. You can pay using a credit card, check, money order, etc, we have also included an order form.

If you have further questions on this aircraft you can contact Bill Clouse at bclosure@panhandle.rr.com.

Regards,

Renee Gelinias
Aircraft Spruce



www.Aircraftspruce.com

STARDUSTER TOO SA300 LICENSE AGREEMENT

For and in consideration of the sum of \$ (current cost) Aircraft Spruce & Specialty Co. of Corona, California, does agree to extend to _____ the right to build one Starduster Too SA300, said airplane to bear serial number _____. Aircraft Spruce & Specialty Co. further agrees to supply one set of construction drawings and an illustrated parts catalog.

Your Customer order number is:

This section to be signed by Aircraft Spruce representative
By _____
Title _____
Date _____

I, _____ address _____ do agree to the conditions set forth above and in consideration thereof I further agree that said drawings, instructions, and manuals will remain the property of Aircraft Spruce & Specialty Co., and specifically agree to the following:

- A. I will build one airplane only from these drawings and manuals and that said aircraft will conform to the specifications set forth in these drawings and manuals.
- B. I will not allow another party the use of these drawings and manuals to build a second airplane or part thereof.
- C. I will not transfer these drawings to another party without prior approval of Aircraft Spruce & Specialty Co.
- D. I will not allow these drawings, manuals or instructions to be duplicated.
- E. I will not use or permit the use of these drawings in the design, construction or manufacture of another aircraft.

It is further agreed and I understand that Aircraft Spruce & Specialty makes no warranty, expressed or implied, as to the quality or the safety of this airplane. The buyer understands that no warranty, express or implied, is being given by the Seller or the Buyer as to the accuracy, airworthiness, suitability or flyability of the Plans or the aircraft or engine to be built with the Plans or that the airplane or engine once built is able to be licensed by the Federal Aviation Agency. The Buyer of the Plans shall accept full legal responsibility for the construction, licensing, flight or operation of the aircraft or engine and hold totally and completely harmless from any legal liability or damages whatsoever the principals, owners and employees of Aircraft Spruce and Specialty Company. Further understand that any aircraft constructed with the Plans shall only be built and operated in strict compliance with the Federal Air Regulations promulgated by the Federal Aviation Agency. It is also agreed that while Aircraft Spruce will try to direct any questions regarding the Plans and construction to experienced builders, Aircraft Spruce itself cannot provide any technical builder support on the Starduster Too SA300. All subsequent buyers, heirs, successors, or assigns are also bound by all terms of this agreement.

Work Ph. _____
Home Ph. _____
FAX _____
E-Mail _____

Signed _____
Date _____
Witness _____
Address _____

Inasmuch as Aircraft Spruce & Specialty Co. has no opportunity to supervise the manufacture, installation or maintenance of the parts supplied by it, nor any opportunity to participate in the design or manufacture of the various certificated and homebuilt aircraft in which its parts are utilized, the purchaser by placing this order and accepting said merchandise from Aircraft Spruce & Specialty Co. agrees that all materials purchased will be solely at purchaser's risk and that purchaser will indemnify and hold Aircraft Spruce & Specialty Co., its owners and employees, free and harmless from all loss, liability or damage resulting from claims brought by reasons of any alleged failure or defect of any part or parts supplied by Aircraft Spruce & Specialty Co.

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STARDUSTER TOO SA300 LICENSE AGREEMENT

For and in consideration of the sum of \$ 250.00 Aircraft Spruce & Specialty Co. of Corona, California, does agree to extend to _____ the right to build one Starduster Too SA300, said airplane to bear serial number _____. Aircraft Spruce & Specialty Co. further agrees to supply one set of construction drawings and an illustrated parts catalog.

Your Customer order number is:

This section to be signed by Aircraft Spruce representative
By _____
Title _____
Date _____

I, _____ address _____ do

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- D. I will not allow these drawings, manuals or instructions to be duplicated.
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