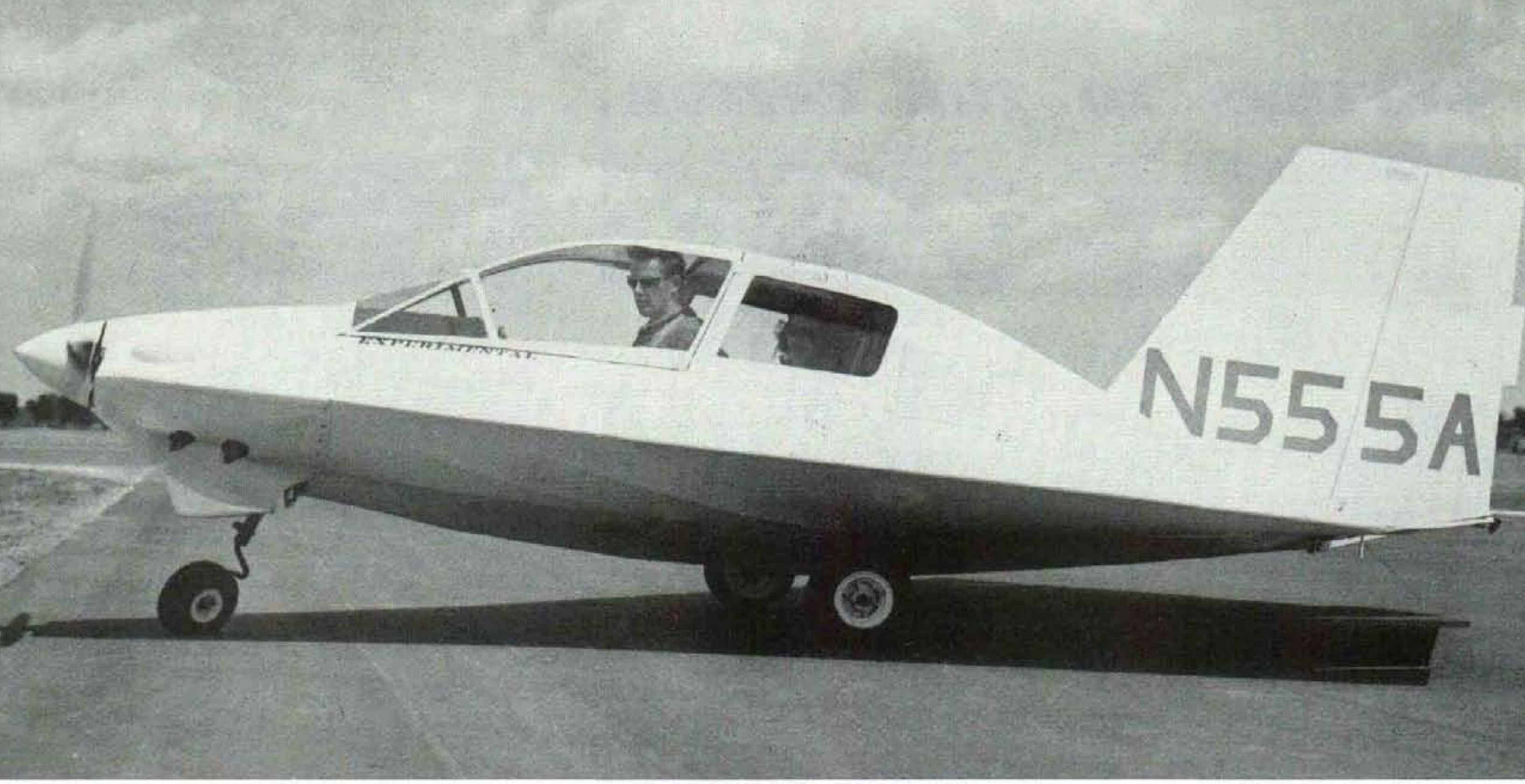

THE DYKE JD-1 "DELTA" (Photo by James Hawkins)

Evolution Of The Dyke Delta

By John W. Dyke, EAA 3566
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MY "DYKE DELTA" airplane, which many saw at the 1963 Rockford meet for the first time, got its start several years ago when I put some radically shaped airplanes into sketch form. Model building naturally followed the initial brainstorming. The models were crudely built and flown at the ends of control lines, and when something had been learned from them I progressed to free-flight models built to scale in every respect.

From those models came the final design, which had a lot of compromises in it to achieve my goals of roadability and ease of construction. When the final design had been developed, I built a solid scale model of high accuracy to use on a test rig which I had mounted on my car. This rig was, in a sense, a wind tunnel, the model being mounted on a full-swivel bearing located at its center of gravity. It had control surfaces which could be pre-set to make it fly at any desired attitude.

The test rig was calibrated in ounces and pounds and could measure lift and drag. An airspeed indicator and free-air thermometer completed the device. By driving into the wind, it was possible to read off the actual lift and drag created by the model. The most valuable information derived from these tests was to locate the craft's actual neutral center of pressure location.

Next, an .049 model airplane engine was mounted in the nose and properly cowled in. More tests were made with the engine running, and a startling difference was noted in results — lift was increased by from 35 to 40 percent, the model was exceptionally stable, and the engine thrust did not change the trim any because the thrust line was symmetrical with airfoil and center of drag.

The value of model testing was proven when the big plane finally flew. Last November, another delta plane was also flown here in Dayton, Ohio; it is a pusher by Dr. Lewis Jackson and is of radical design. Thought up by Dr. Jackson and myself, its design was subjected to model test. For both delta designs, model testing produced information on landing speed, top speed and sta-

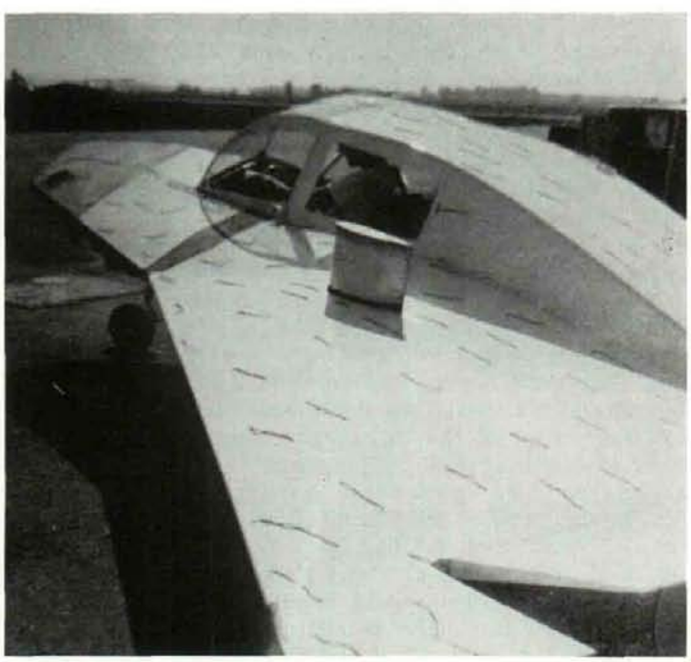
(Photo by Robert F. Pauley)
John W. Dyke poses with his JD-1 "Delta." The translucency of the fiberglass cowling can be noted behind the propeller hub. At this time, the cowling was unpainted and the spinner had yet to be added. This cowling, however was destroyed and had to be replaced.

bility factors. In the actual airplanes, the figures obtained from models proved to be within five percent of the performance figures turned in by the larger craft.

Actual construction on my "Delta" began September 16, 1960, and the first test flight was made on July 22, 1962. Construction of the fuselage, wing spars and tail assembly is steel tubing. Wing ribs are made of .019 in. steel channel and are nickel-silver brazed onto the front, main and rear spars. Cap strips are of .020 in. stainless steel double-beaded channel stock. The ribs have Pratt trusses, which makes them very strong and light.

The skin is of laminated fiberglass .065 in. thick, and is fastened to the capstrips with 100 deg. countersunk DuPont explosive rivets. My wife, Jenny, did all the riveting, and very few of them were bad. Since the plane was completed, I have been asked numerous times how these rivets have held up in the fiberglass. As this is written, the plane has been in operation for a year and a half and has logged about 120 hrs. — and the rivets are still tight. I had to replace some of them in one panel, but that panel was one on which I did not allow any curing time before riveting, whereas the others were aged for two weeks. Fiberglass tends to shrink as it cures and if it is drilled and riveted while still "green", it tends to shrink away from rivet heads and cause loosening-up. The various panels averaged .065 to .070 in. thick, their resin content is about 60 percent with three layers of 10 oz. cloth, and weight is .42 to .43 lbs. per sq. ft. Cost of the fiberglass skin averaged out to 65 to 70 cents per sq. ft.

The entire airplane is fiberglass covered except under the fuselage and the control surfaces. At those places Dacronite is used; it is the same as Ceconite but much cheaper. Nitrate dope is used on the Dacronite. The gasoline tank is also of fiberglass—polyester with a seal coat of epoxy which is quite flexible to withstand vibration. There have been some minor pinhole leaks, but this was caused by the tank being pressurized too much in cruising flight. I repositioned the air pick-up to the top of the tank to lower air pressure and this stopped the leaking. Capacity is 25 gals.



Airflow tests on the "Delta" were made with tufts attached over the airplane, and the flow can be observed here with the engine running. Note an earlier style windshield and canopy arrangement installed at this time.

(Photo by Robert F. Pauley)

The cockpit canopy of the Dyke "Delta" forms an airfoil section matching the wing section. Certain areas of the plane, such as the engine cowling, were not painted at the time this photograph was taken.

Altogether, the ship has had three engine cowlings. The second was to improve upon the first one and had less frontal area and better appearance. A piece of styrofoam 4 in. thick was the basis for the nose piece. I filed and sanded it to shape. Sheet aluminum was taped to the styrofoam nose piece and to the firewall. To this nose piece and aluminum I glued Dacronite, using a former for the bottom centerline. The Dacronite was shrunk with a flatiron, and then the whole cowling was fiberglassed with epoxy and three layers of 7½ oz. cloth. When finished, it weighed 11 lbs., and worked very well.

Unfortunately, it lasted only two weeks. During some ground engine-runs it was removed and placed on the ground about 10 ft. in front of the plane. When the engine was running at full throttle, the cowling was either blown or sucked into the prop disc, and that was that—and only seven days before the 1963 Rockford Fly-In! Thanks to the untiring efforts of Chapter 48 members including Clem Hively, Lou and Ann Brenthaur, Frank Swartzel and my very understanding and cooperative wife, I was able to make a new one and so attend the Fly-In. The third cowling is like the second one. Jenny undertook the job of rebuilding my completely shattered morale after that cowling accident!

Landing gear legs are made of round 6150 steel stock, bought in annealed condition. The nose gear is of ¾ in. diameter and the main ones 1 in. diameter. There is no machining on them. The nose leg was heated and bent to shape, then drilled and threaded. That worked, so the main legs were done in the same manner. Then all three legs were heat treated, installed in the plane and drop-tested with a full load. Both main legs broke, so I took them back to the heat treating firm and it developed that they had not controlled the heat very closely. Rockwell hardness varied from 40 to 52 in the region of the breaks so new gears were made, heat treated more carefully, and drop-tested. Their Rockwell hardness is a constant 42 and they worked nicely. After each of the several drop-tests to which they were subjected, they were Magnafluxed and found to be sound. A simple hand lever and scissors arrangement retracts them, and with the wheels up, the plane's cruising speed is 15 mph higher.

The plane has the elevon and rudder type control system, the rudder being operated by cables, and the elevons by one tube which has both push-pull and torque action. It travels from the stick back to a "mixer assembly" which mixes aileron and elevator action together to give 25 deg. up elevator, 8 deg. down elevator and 12 deg. differential action at any elevator position. Elevon area is 18 sq. ft. and wing area, including cowling, elevons and propeller spinner is 158 sq. ft.

(Continued on next page)

(Photo by Robert F. Pauley)
Visible in this front view of the Dyke "Delta" are the streamlined fairings on the upper wing surfaces which conceal the hinges for the folding wing tips. The mast on the wing to the right of the picture is actually a fence post behind the airplane.

DYKE DELTA . . .

(Continued from page 5)

The wing has the 62_2-012 airfoil modified with a smaller leading edge radius. The wing is untwisted and has no dihedral. Sweepback is 63 deg. at the center section and 57 deg. in the outer panels. The outer panels fold up over the top by removing four "pip" pins. Folded width is 7 ft. 4 in., and the aircraft is towable and very stable on the highway at speeds up to 70 mph. The canopy is airfoil-shaped to the top half of the 2418 airfoil, somewhat modified.

The Dyke "Delta" is meant to be self-propelled on the ground via an auxiliary engine but I did not get that far yet. Dr. Jackson's delta pusher mentioned previously is self-propelled and has good roadability, but I want to watch it some more before deciding whether or not to continue the self-propelled phase of the project.

Flight characteristics are very conventional except for the rather high 18 deg. angle of attack for landing. The take-off is conventional, but has one quirk worth knowing about. Ground effect is very noticeable and leads to a tendency to lift off sooner than is desirable. It will lift off and rise until it has flown up out of the ground effect, and then settle back to the runway. Therefore, safe take-off technique is to force it to stay on the runway until good speed has built up, before letting it fly itself off. This speed varies according to load, the lowest being about 60 mph, and highest about 75.

(Photo by Robert F. Pauley)
The control wheel on the instrument panel in this cockpit view of the "Delta" is for steering the airplane while taxiing.

Best climb speed varies from 100 to 125 mph, depending on the load. Approach speeds are about the same. The craft is very stable, much to my relief, although it rides roughly in turbulent air when slowed down during climbs or approaches. Maximum cruising speed at 7,000 ft. standard day conditions is 150 mph, top is 170 using a 65-66 prop. The original propeller was a 66-66 but, needing more power for the take-off with full load, I clipped one inch from the tips. This gained 75 rpm at take-off, but lost me about 8 or 10 mph cruising speed. Power is a Lycoming 0-290-G4 modified to 0-290-D configuration. Empty weight is 725 lbs. and gross weight 1,400 lbs. Originally, I wanted it to have 22 ft. wing span, but in order to build the plane in my basement I had to limit it to 18 ft. This hurt load-carrying ability. I might lengthen the wings or install a larger engine, because there are now five in my family and I need more load-carrying ability.

My experience with this airplane has taught me much about delta designs and I should like to express some thoughts which have occurred to me about the fatal crash of the Dean delta a few years ago. The pusher propeller on that craft must have had a pronounced effect on longitudinal trim. Had his wind tunnel model been fitted with an engine and tested with it running, I feel he would have realized some changes were needed in the control system. The elevator area was only 8 sq. ft. and located directly in front of the propeller disc. That was not enough for proper control at any time and, as some have pointed out, particularly with it deflecting air into the propeller disc. If the ailerons had been connected with the elevators to give elevons, there would have been much better control response.

But still, it would have been necessary to deal with the moment caused by the thrust force about the rotation point of the main gear, plus the moment caused by the center of gravity being so far forward of the main gear. Use of full power on the take-off prevented raising the nose gear until a very high ground speed had been attained, and not even then until power had been cut and therefore removed the thrust force about the main gear while at the same time helping pull the nose up by reason of the drag created by the decelerated propeller. This is what caused the abrupt climb. If there had been more elevator area it might have been possible to raise the nose gear before reaching such high ground speed.

Or, the nose gear could profitably have been made longer to give the plane an attitude of about 6 deg. As was pointed out in *SPORT AVIATION* a while back, Dean's plane could only attain an angle of incidence of 8 deg. due to the presence of a tail skid and pusher propeller. I agree that that is not nearly enough for land-

The main wheels of the Dyke JD-1 "Delta" retract toward the rear, but the nose wheel remains in the down position at the present time.

ing, but feel that it could have been flown off—though my figuring gives 90 mph as the lift-off speed. I lay Dean's accident to control deficiency and to the center of gravity being too far to the rear. His inexperience was, in my opinion, a minor factor . . . it contributed **after** he got into the air, but even then he did everything anyone else would have done to correct the plane's attitude. I feel he was too anxious to get the plane into the air and did not give it enough ground testing.

Now, back to my own machine. It took a lot of time and work to realize my dream, but now it has come true and my family and I have greatly enjoyed flying around the midwest in the ship. In addition to helping a lot on the actual construction, Jenny helped by giving lots of encouragement and doing without a lot of the fine things in life she might have liked. But yet, what can be finer than designing, building and flying your own airplane about the country with the whole family along — and drawing a crowd of admirers at every airport? It makes one feel very proud indeed!

I owe thanks to many people. Paul Poberezny for one, for making it possible for us to build experimental aircraft. The FAA for another, for relaxing the old regulations enough to let us get into the air. I am particularly indebted to Bill Gleason of the Dayton Engineering and Manufacturing branch of the FAA, and his boss, Ernest Miller. Mr. Gleason came to inspect and license the Dyke "Delta" on a Saturday during his vacation so that it would be possible for me to attend the 1962 Rockford meet—and it was just my hard luck that another branch of FAA containing a different breed of men stepped in to prevent my going. Let it be known that the acts of interest and understanding by FAA personnel such as Mr. Gleason do not go unnoticed and unappreciated!

To any EAA member planning to build a delta-wing aircraft, this is my advice. Such an aircraft can be a very pleasing one and as safe as anything else flying. Or it can be quite the opposite. Study delta-wing theory thoroughly—and when you get to flight testing start out with the CG well forward and spend some time on the ground. Don't allow the airport gang to influence your better judgment — and believe me, I know that you **can be influenced** to get it up! If you feel your are not quite capable of dealing with some radical flight manner, then enlist the aid of someone with a lot more flight experience to help with the testing.

With such common sense and good judgment, I predict we will be seeing many more delta-wing homebuilt planes in the future—safe and successful.

LETTER FROM JOHN DYKE

Dear Paul:

This is my seventh year as a member of the EAA, and I can attest to the fact that they have been enjoyable if not fruitful years for my wife and I . . . being, of course, that I have designed and built my airplane in this period.

Through the coming years, I hope to build again, as once this "bug" has bitten, you have just had it! And when I do build again, it will be strictly experimental, of course. I realize that there are only a few of us members who build airplanes so differently, but through the efforts of so few of us, will come a lot of new engineering principles, methods and, of course again, new type airplanes. The interest shown by commercial aircraft builders to my aircraft has proven that.

I only hope that the EAA will continue to support the efforts of experimenting members as well as those who build proven types.

Sincerely,
JOHN W. DYKE

Li'l Twister . . . No Twister

THERE APPEARED in the "Chatting With the Chapters" column in the November, 1963 magazine mention under Chapter 40 of an aircraft recently restored by Dick and Pat Day. This aircraft is not a "Knight Twister", as was presumed and so stated. Though it is now known as "Li'l Twister", N-72L, it is actually an original design biplane built in 1931.

The little biplane was acquired by the Day brothers, and completely restored from the "old bones." This airplane was also pictured on page 39 of the September, 1963 magazine.

While it may not be a real "Knight Twister", it certainly looks as though it could be related to the design. The wing span is 13 ft., and the length is 14 ft. A Lycoming 0-145-B of 65 hp does most of the work, and cruises the airplane at 140 mph at 5,000 ft., swinging John Thorp's racing propeller.

The "Li'l Twister" is completely upholstered inside, and is covered with Eonex, finished off in red and white. Patrick E. Day, EAA 15029, one of the owners, lives at 4827 Sepulveda Blvd., Apt. 9, in Sherman Oaks, Calif. The brothers were ably assisted in the test flying by Earl Lauer, president of Chapter 40. Pat Day is presently building a Bowers "Fly Baby."