



Giving the Cub a New Lift

Dakota Cub's Slotted Wing

by Peter M. Diemer with Ken Smith
photos by George A. Kounis

Ordinarily a climb at 20 to 25 mph in a Cub would be cause for concern, but today *Northern Pilot's* Cub man Ken Smith and I weren't flying any ordinary Cub. We were taking up Jim Pазsint (of Alaskan Bushwheels fame) on his invitation to fly his newly rebuilt PA18-160, equipped with slotted wings by Dakota Cub. Pазsint, always looking for new, or in this case newly reapplied technology, purchased the very first set of production slotted wings from Dakota several years ago and then spared no expense in building one of the finest Cubs around. Equally impressive is N7470D owned by George Goundry, which features the latest refinement of the slotted wing (piloted here by Mike Butterfield).



Slot Simple

Leading edge slots allow the wing to fly more slowly prior to reaching the critical angle of attack. Essentially, the slot delays airflow separation by allowing high-energy air from under the wing's leading edge to pass through the slot and over the top surface. A slot is commonly confused with a slat. A slat is a permanent wing fixture, whereas a slot is a movable device that opens to create a slot and then is closed while at lower angles of attack. The Helio Courier, for example, features a full-span slat, while a Stinson 108 uses a slot on the outboard portion of the wing. The slot is also different from a vortex generator (VG). VGs create a controlled turbulent flow in order to re-energize the airflow and delay separation while the slot generates a more laminar flow.

Founded 13 years ago by Mark Erickson, Dakota Cub has quietly developed an extensive product line of PMA'd STC'd replacement parts for the J3, J4, J5, PA11, 12, 14, 18 and 20/22. Erickson started with wing ribs and then added components, growing his STC list. Within four or five years, he took on larger assemblies and now offers total wing assemblies complete with fuel tanks and flight controls. Virtually all the parts are improved upon and incorporate all of the popular modifications developed over the last 60 years of Cub flying.

The slotted wing design traces its roots back to the original Piper Aircraft Company and World War II. Toward the end of the war, Piper developed the YL-14 liaison version of the J5C (predecessor to the PA12)

for the U.S. military, featuring the forward leading edge slot. According to Erickson, the military desired an airplane that could take off in 100 feet and climb at extremely steep angles. In total, 14 examples were built before the end of the war. Two are still flying, one in Nebraska and the other in Spain (see sidebar *Piper L-14 Army Cruiser*). Erickson decided to research the L-14 and pursue an STC for the installation of an L-14-style wing on a PA18 airframe for those who want the ultimate in Cub STOL performance.

For all you rabid Cub performance enthusiasts out there who are reaching for your reciprocating saw to start carving a slot on your stock Cub wing, don't... put the saw down and slowly back away from your airplane. The Dakota slotted wing is a completely different wing than the stock Cub wing and is really an enhanced L-14 wing as well. Since Piper used a 35B airfoil for the L-14, Erickson had to adjust the slot to work with the modified 35B airfoil used on the 18.

"We put the wing through an extensive static and flight testing program," said Erickson. "We consulted with aeronautical engineers to modify the slot for the Cub and conducted many tuft tests."

Structurally the wing is also different. According to Erickson, the wing has been tested up to 2,250 pounds, but is limited

to 1,750 pounds, or 2,000 pounds if equipped with the Wipaire One Ton Cub STC. Dakota uses a truss style rib, which, according to the company, is stronger than a stamped rib but weighs a bit more. The company estimated that the ribs add about seven pounds per wing. The leading edge (which forms the front of the slot) is all aluminum, as is the rear of the slot. The remainder of the wing is fabric-covered. The slot adds about nine pounds per wing to the weight of a stock wing.

The first versions of the wing delivered by Dakota featured flaps enlarged by 44 percent (measuring 90.25 inches) and round tip bows. The current version of the wing is the so-called extended wing and includes enlarged flaps, standard size ailerons relocated to the wing tip, and squared-off wing tips.

The extended wing's span is identical to the stock wingspan; wing area is gained, however, by squaring off the wing tip by the elimination of the tip bows. Since Dakota manufactures the new spar intended for use with the square tip, the Dakota spar is lighter than a modified spar due to the elimination of heavy reinforcing plates required to make the square tip modification to a stock wing in the field.

Erickson didn't invent the slot, squared tip, extended flaps, or outboard aileron configuration, but he did certify an all-new

**EACH TIME, THE DAKOTA CUB WANTED
TO FLY UNTIL THE SPEED DROPPED TO
25 MPH OR LESS.**

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Mike Butterfield and George Goundry fly George's Dakota Slotted Wing Cub near Stevens Pass in the Cascades. Its combination of good visibility and slow flying capabilities make it a good mountain-flying airplane.

Photos by Peter Diemer



Jim Paszint took delivery of the first certified slotted wings by Dakota Cub, around which he built 66C.



THE SLOTTED WING DESIGN TRACES ITS ROOTS BACK TO THE ORIGINAL PIPER AIRCRAFT COMPANY AND WORLD WAR II.

In Flight

So, how well do the wings fly? Slowly, if you like. First the top end. Here is one of the few times where the high drag of the Cub is an advantage. The slots do increase drag, but since drag is a function of speed, how much you will lose in cruise is dependent on your airplane. A sleek Cub with four-inch tires, all fairings installed, and a fresh wax job will lose about four to five mph, according to the factory. Bush monsters with extended gear, big tires, off-road landing lights, check cables, and the like won't lose much.

On the slow side, things are a bit more difficult to quantify. Unfortunately, we didn't have a Differential GPS unit available for this flight review (see June/July 2001 *Northern Pilot*) and standard airspeed indicators are notoriously inaccurate at high angles of attack and slow speeds. We can report, however, that 66C flew at 20 mph indicated at 93 percent of gross weight. The takeoff ground roll will, of course, vary on the tires, surface, temperature, wind, and technique. On the day of our flight, the density altitude was about 1,950 feet.

Piper L-14 Army Cruiser EC-AAP

by Robin D.W. Norton

One of two original L-14s in existence, EC-AAP was constructed by Piper and registered on December 18, 1945 with construction number 5-3007 and USAAF number 5-55531. After the military cancelled their order for 850 L-14s, it was sold on the civil market as NC-41594. Then in March 1946, this Piper L-14 was exported to Cuba as CU-P18, later to become CU-N18 before being exported by sea to Spain in March of the following year.

Between 1947 and 1957, the aircraft flew all over Spain and North Africa (Morocco) as EC-AAP publicizing a well known beverage, including banner

towing, before a long storage in a dry hangar in Leon, Spain. In 1995, Jose Luis Olias purchased the aircraft and moved it to Burgos, Spain for a detailed restoration.

Olias, who was recently elected President of the Royal Aero Club of Spain (Real Aero Club de España), one of the oldest and most prestigious aero clubs in the world, will

long remember the year 2003—the year when all his hard work and dedication were rewarded with being able to fly the aircraft that he restored with the assistance of people from around the world.

Visit www.piperL14.org for more information or www.A2Oxford.info for photos by Robin D.W. Norton.

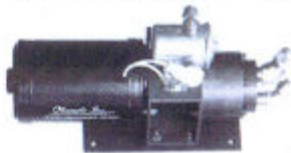


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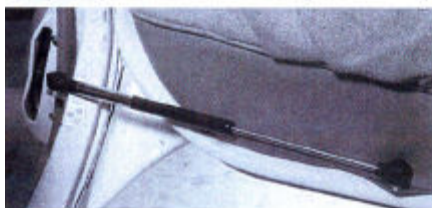
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We established a climb of 500 fpm at 25 mph and 1,500 fpm at 40 mph—impressive numbers. The FAA-approved Flight Manual Supplement (FMS) provided by Dakota Cub states that the Dakota Cub STC reduces climb performance by five percent although the FMS is unclear if this applies to climb angle or rate. In our experience, climb angle is increased and any reduction in climb rates was undetectable.

Smith felt comfortable maneuvering at altitude with one notch of flaps and 30 mph. The deck angle is steep and power is required to hold altitude (2,100 rpm with a Borer prop). Bump up the power to climb or to hold altitude during a turn. We made 30-degree bank turns in both directions and Smith reported feeling only a bit of stick "nibble" when in the turn at

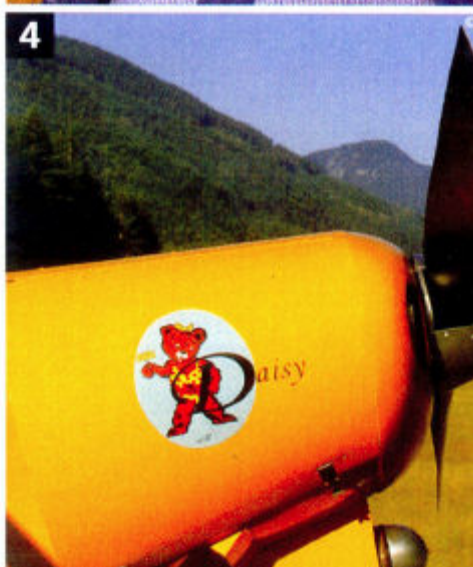
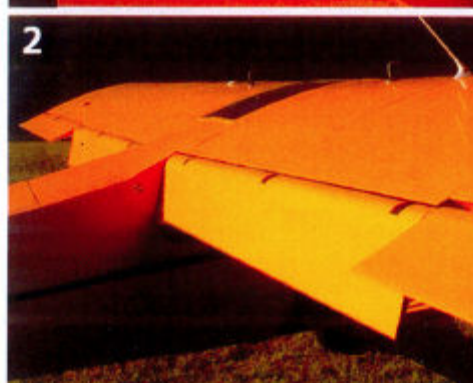
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THERE WHO ARE
REACHING FOR YOUR
RECIPROCATING SAW
TO START CARVING A
SLOT ON YOUR STOCK
CUB WING, DON'T...
PUT DOWN THE
SAW AND SLOWLY
BACK AWAY FROM
YOUR AIRPLANE.**

30 mph. We didn't explore the stall behavior at altitude; however, demonstration pilot Mike Butterfield reports that the slotted wing mashes out when stalled, with no tendency to drop a wing. This is also noted in the FMS, which states that the Dakota Slotted Wing Cub "may not break, particularly power off."

"It [Dakota Cub] just flies and flies," said Butterfield. "If you want to climb, just add power; if you want to descend, just pull a little power back."

While we didn't attempt any stalls at altitude, we did them during landing. We found that once the wing is done flying, it does quit abruptly. The stick is already near the aft limit and no increase in back stick will reduce the descent rate once the wing stalls.

Intentional spins are prohibited in the Dakota Cub. The FMS does state that "under normal loading conditions the modified airplane is resistant to spins." Interestingly,





1. The slot opening is made from formed aluminum.

2. The original Dakota Cub wings like those used on 66C (preceding page) had round tip bows. The current version (shown here) employs a square wingtip, extended flaps, and aileron relocated outboard to the wingtip. This configuration greatly improves aileron response and authority.

3. N7470D's panel is close to stock. In addition to Garmin avionics, a notable addition is the gear switch and indicator for amphibious floats.

4. When George Goundry's wife vetoed Vargas nose art, George commissioned Sam Lyons to paint "Daisy" on the nose. The name comes from the last letter of 70D's call sign and the aircraft's trademark yellow color.

5. The slot spans nearly the entire wing.

6. Jim Papsint uses a three-inch Atlee Dodge gear extension and 31-inch Alaskan Bushwheels on 66C. The gear extension combined with the large tires allows the pilot to take full advantage of the slot's slow-speed capability.

7. The engine in 70D was tilted up four degrees to line it up with the aircraft's longitudinal axis with a mod from Thrustline Products of Alaska.

according to Erickson, the original L-14 had a placard on the instrument panel, which stated: "This aircraft is characteristically 'incapable' of spinning within the approved CG range and control surface travel limits."

The few convective bumps illustrated the advantage of the outboard aileron configuration, which is now standard. The stock ailerons on a Cub are not overly snappy as it is and are even less so at 20 to 30 mph. Both Erickson and Butterfield attest to the improved roll response of the relocated ailerons. Smith's personal Cub incorporates such an aileron configuration, and he noted that the handling is greatly improved.

On short final, we experimented with different speeds, each time slowing the final approach speed as we gained familiarity with the envelope. There was a six-knot crosswind from the left. Eventually, we slowed to 35 and then 30 mph on short final. Each time, the Dakota Cub wanted to fly until the speed dropped to 25 mph or less. At 20 mph, aileron authority was diminished (it has since improved with the relocated aileron), and Smith reports that the rudder and elevator were sluggish as well. At this point, a six-knot direct (or nearly so) crosswind becomes a real consideration. Of course we were pushing to an as-slow-as-possible full-stall landing and an increase in speed would have improved flight control authority.

Custom Options

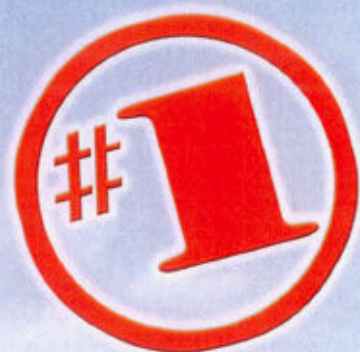
If considering the switch to slotted wings, be sure that your airplane is configured correctly and flies straight with clean rigging. A three-inch gear extension and large tires are helpful, as they allow you to take full advantage of the slot's slow speed capabilities while keeping the airplane within landing gear geometry limits. Short gear and small tires will result in tailwheel-first landings and a less than optimal takeoff run. 66C is configured with three-inch extended Atlee gear and 31-inch Alaskan Bushwheels—a combination that makes for a nose-high, three-point attitude required to optimize the slot. A well-rigged airplane will fly better at slow speeds, providing better control authority and more predictable behavior.

The Dakota Cub wing offers pleasant flying qualities, all new construction incorporating the best modifications available, improved slow-speed performance with little drag penalty and perhaps an increase in safety. While the slot apparently tames the Cub's stall behavior, it also allows flight at a very slow speed. With this, come the associated control challenges. Pilots need to weigh their need for a super-slow landing against the current wind conditions and available landing area and adjust their approach as necessary. There are times when a full super-slow landing is needed and can be performed safely and there are times when it may be better to carry a touch more speed to retain a bit more control.

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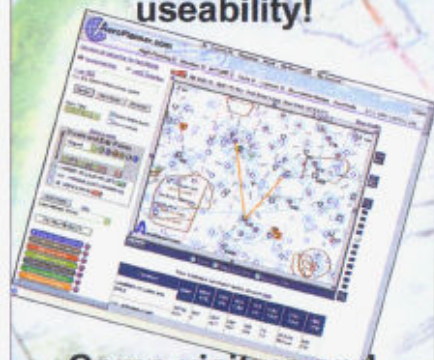


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N7470D has a wide speed range that permits quick flights to remote destinations, followed by slow, steep approaches at mountain airstrips. The airstrip at Skykomish (below) is four to five times longer than pilot Mike Butterfield needs.

Pazsint commented during our preflight briefing that an airplane requires forward motion for both flight and control while a helicopter does not; don't try to make a landing with a Dakota Cub slotted wing that is best left to a helicopter. With that realistic consideration, Pazsint states that he loves his wings and that they allow him to fly at gross from his favorite hunting locations with better climb performance and a much larger margin of safety.

Dakota offers their wing in several versions, slot or not, and choice of 18- or 23-gallon fuel tanks. All of the wings feature square tips and come complete with new 90.25-inch flaps and 102-inch ailerons. New standard wings are \$17,400 and the slot option adds another \$2,500. One neat option is to have the Wipaire One Ton Cub STC (www.wipaire.com)



installed at the Dakota factory. Installation of the wing portion of the modification is free if you purchase the kit from Dakota. While all of the manufacturing is accomplished at the South Dakota facility, Erickson has established retail centers in the greater Anchorage, Alaska, area as well as a wing completion center in Soldotna, Alaska—great for Alaska pilots who can save on shipping costs.

If you are looking to rebuild or just want more performance, the Dakota Cub wings will give your Cub a new lift. ■

For more information, contact Mark Erickson, Dakota Cub Aircraft, PO Box 797, Brandon, SD 57005, (605) 757-6628, dca@ideesign.com, www.dakotacub.com.