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TOP CUB CUBCRAFTERS' SOUPED-UP SUPER CUB



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CubCrafters TOP CUB

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Making a Good Airplane Even Better

by John T. Kounis
photos by Jessica Ambats
and George A. Kounis

Like most superior craftsmen, it seems CubCrafters president Jim Richmond is not satisfied with the phrase “It’s good enough.” For decades, the words “Super Cub” have been synonymous with virtually unlimited backcountry performance. Yet CubCrafters has built a reputation on rebuilding and making Super Cubs even better for the last quarter century. The latest development in their never-ending refinement of the Super Cub line is the new TOP CUB. On the outside, it looks just like the venerable Super Cub that bush pilots around the world know and love. But on the inside, it is a modern airplane, certificated to the latest FAR 23 standards, with more useful load, a reinforced airframe, and modernization and improvements throughout. I was lucky to spend a couple of days with the CubCrafters staff flying to grass strips and through remote canyons in the Cascade Mountain Range,



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and having a great time putting this new airplane through its paces.

History

Jim has been in the Super Cub business since 1980. He started rebuilding Italian L-21s (military versions of the PA-18-135), and progressed to rebuilding 15–25 civilian

Super Cubs annually. He estimates that he has either owned or worked on 10 to 20 percent of all U.S.-registered Super Cubs. Over the years, CubCrafters refined the rebuild process until they ended up building essentially a brand new airplane—after replacing the fuselage, wings, tail feathers, flight controls, and instruments,

it seemed the only original part left was the data plate.

Finally, an FAA inspector suggested that CubCrafters assemble brand new airplanes under the “Spare and Surplus Rule,” since, in essence, they were building a new aircraft with PMA parts anyway. This rule authorized issuance of a *new* airworthiness certificate if it could be demonstrated that the aircraft complied with the original type certificate. In 1998, they started manufacturing all-new airplanes under the rule; in all, they delivered 75 CubCrafters PA-18-150s through Summer 2004.

In 2000, the FAA started making it increasingly difficult for CubCrafters, and it looked like legislative changes could shut down production. Jim set plans into motion to obtain his own type certificate in 2002. Although the original PA-18 was certificated under CAR 3 rules in 1949, CubCrafters had to comply with newer FAR 23 rules, amendment 55 (the rules in effect in August 2002, when they applied for the type certificate).

Among the new requirements was FAR 23.562, which could be the biggest obstacle to certification of new airplanes today. It requires that seats withstand a dynamic test of 26 G forward deceleration and 19 G downward deceleration and not let the pilot’s head hit the instrument panel or



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ON WHEELS, IT’S NEARLY IMPOSSIBLE TO FLY A TOP CUB OVER GROSS.

The Factory

In their 40,000-sq.-ft. facility at the Yakima Airport in south-central Washington, CubCrafters employs “lean manufacturing,” a process designed and perfected by Toyota that minimizes parts inventory. Each week, all the steps are completed to produce one TOP CUB from start to finish. There is no “dead inventory”

sitting in the way of production, and the cost of holding and storing those parts is eliminated.

By the end of the week, just enough parts are ordered or manufactured for the coming week. The benefit is that the process is agile, and design improvements can take effect immediately. For example, CubCrafters implemented a shock-mounted instrument panel early in TOP CUB production. They put the change into effect as soon as the FAA approved the drawings, rather than waiting to deplete an inventory of non-shock-mounted instrument panels.

In order to quickly change tooling and produce a large number of different parts, the machining equipment is computer numerical controlled (CNC). A CNC milling machine can, for example, produce an axle one moment, and quickly switch to producing a fuel gauge the next.

CubCrafters’ CC18-180 TOP CUB incorporates vast improvements over the original Super Cub design. It is an excellent short field performer, with 550 lbs. more gross weight.



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cause him to break his back. (In comparison, airline seats only require up to 16 G.)

To meet this daunting requirement, CubCrafters turned to Oregon Aero, which had years of experience in seat design for both the military and civilian markets. Together, they designed a seat and harness system that met all requirements.

Once the seat was approved, development of the rest of the airplane continued. The result was a TOP CUB with 550 lbs. more useful load, a stronger airframe, wings, and landing gear, and design improvements throughout. CubCrafters received the TOP CUB type certificate on December 16, 2004. It is the sixth general aviation type certificate granted in the U.S. since 1985.

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CubCrafters is currently producing TOP CUBs at the rate of one per week. When the new SPORT CUB line is operating, they expect to produce five airplanes per week (see sidebar). With all the construction on new airplanes, I asked Jim whether their rebuild business had slowed down. Actually, they continue to rebuild Super Cubs more feverishly than ever before.



CubCrafters draws on their years of experience in Super Cub rebuilds to manufacture all-new TOP CUBs.

The TOP CUB

One of the most impressive features of the TOP CUB is its 2,300-lb. gross weight. On wheels, it's nearly impossible to fly it over gross. Let's say you take a 1,200-lb. TOP CUB, add 50 lbs. of options, fill the 50-gallon fuel tanks, and then fill all baggage compartments to the maximum capacity with 210 lbs. You can then still load a 300-lb. pilot and a 240-lb. passenger and not exceed gross weight. This is an airplane where you can truly fill the seats, fill the tanks, fill the baggage area, and still fly (legally).

The gross weight increase required strengthening the fuselage, wing, wing struts, and landing gear, but added only 35 lbs. CubCrafters starts with a steel fuselage manufactured to their specs by Univair. Changes from a Super Cub include a stronger "roll cage" around the cabin and hard mounting points for shoulder harnesses along with eleven cargo hooks that are tested to 1,000 lbs.

each. (The FAA only requires 50 lbs. x 18 G, or 900 lbs.) Numerous frame members were upped to .049-inch wall 4130 tubing.

As I looked at all the reinforcements and engineering data to support the gross weight increase, I discreetly asked Jim, "You know that Alaskan operators are always operating over gross. We've all probably flown an airplane over gross from time to time. Wouldn't you do it today?"

Jim pulled me aside and showed me a wing spar that had failed during testing. As a result, they added doublers at the critical failure points. He explained, "After seeing how quickly a wing can fail under the wrong kind of load, I wouldn't do it." After seeing that spar, I wouldn't do it either.

When CubCrafters first tested a stock Super Cub wing under loads required by FAR 23 for a 2,300-lb. useful load, the wing failed. They kept strengthening the wing and struts, and re-testing them—four times, in fact—until they could sustain the extra load.

Vortex generators reduce the stall speed to 48 mph and provide positive control throughout the speed range. When comparing its stall speed to that of other aircraft, remember that the TOP CUB's stall speed is measured at a 2,300-lb. gross weight. Since stall speed lowers as weight decreases, my rough calculations show that a TOP CUB should stall at around 42 mph at 1,750 lbs. and around 45 mph at 2,000 lbs. (These are unofficial figures, not endorsed by CubCrafters, but they should serve as a reference point.)

The landing gear is reinforced and lengthened three inches from a stock Super Cub. The longer gear shortens take-off distance by putting the wing at a higher angle of attack, and permits full-stall landings to be made on all three wheels. In the stock configuration, most Super Cubs will touch tail-first in a full-stall landing, and then plop onto the runway—not the best for a soft field. With the 850 tires that come standard, the TOP CUB lands three-point at full-stall, and slightly



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SPORT CUB – CubCrafters' New LSA

At AirVenture 2005, CubCrafters presented their entry into the Light Sport Aviation market, the new SPORT CUB. Rather than modifying an existing aircraft, CubCrafters designed the SPORT CUB as an entirely new airplane. However, much of what the company learned during TOP CUB research and development (e.g. crashworthy seats) has been implemented in the SPORT CUB. CubCrafters projects an empty weight of around 825 lbs., which will yield a useful load of just under 500 lbs. Powered by a 100-hp Continental O-200 four-cylinder engine, the SPORT CUB cruises between 100 and 110 mph while burning 4–5 gph. The base price is \$89,500, and delivery positions can be reserved with a \$2,500 refundable deposit. Customer deliveries are anticipated to begin in March 2006. (Look for a SPORT CUB review in an upcoming *Pilot Getaways* issue.)

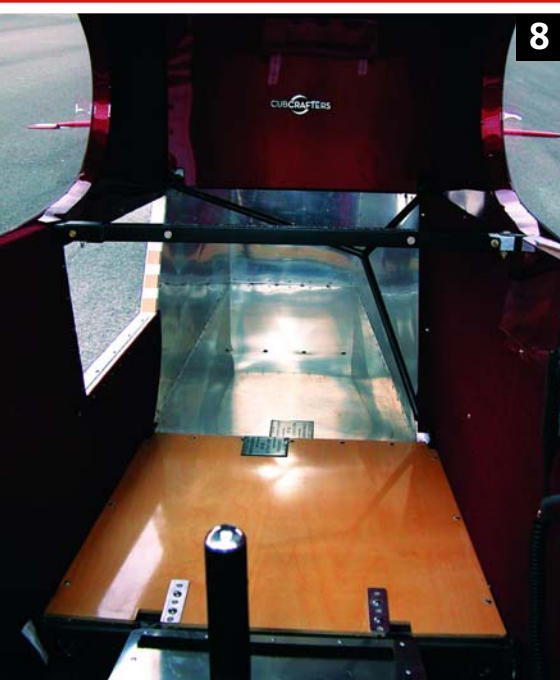


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1. The front seat has been moved back one inch and adjusts fore and aft four inches; the rear seat has been moved back two inches and adjusts three inches fore and aft.
2. A rear-mounted oil cooler provides light weight and better cylinder cooling. Access is easy with a hinged split cowl.
3. The landing gear has been extended three inches. Six-bolt mainwheels and high-pressure stainless steel brake lines are also used.
4. A wide, four-leaf tailspring supports a heavy-duty, two-hole tailwheel assembly.
5. The floating instrument panel increases instrument life. A map pocket on the lower right helps clean up a cluttered cockpit.
6. A strake ahead of the horizontal stabilizer helps prevent a stabilizer stall at low airspeeds.
7. The fuel gauges are calibrated for both three-point and level flight attitudes.
8. The rear baggage compartment can be accessed through an outside baggage door. The rear seat is removable without tools.



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mains-first with bushwheels. Goodyear 26-inch Tundra Tires are optional at \$795. If you intend to land on bowling-ball sized boulders, the ultimate tires are the 31-inch Alaskan Bushwheels. These jumbo radial tires with a Kevlar-reinforced sidewall give the ultimate in shock absorption and soft-surface flotation at \$3,795. Stronger, six-bolt main wheels are used, as well as a heavy-duty Scott two-hole tailwheel (the same one used on the Pawnee), supported by a wide, four-leaf spring.

A 180-hp Lycoming O-360-C4P engine spinning one of three propeller options powers the airplane. A 76-inch Sensenich cruise propeller comes standard; it provides higher top-end cruise speed at the expense of static thrust and takeoff performance. Pilots who want the ultimate in short-field performance and most seaplane operators opt for the McCauley 82-inch propeller, which provides 40–45% more static thrust, a \$1,750 option. In their tests, CubCrafters measured 780 lbs. of static thrust with this propeller—impressive on a 1,200-lb. airframe. Cruise performance for a given fuel flow is not affected, but maximum speed is reduced by approximately 15 mph. Pilots who want a nostalgic look can opt for the 80-inch wood Sensenich propeller. It is roughly 20 lbs. lighter than the metal propellers and is smoother since the wood absorbs vibration. However, it is more susceptible to erosion, particularly in floatplane applications.

The fuel tanks were tested to 6.2 psi, as opposed to the 3.5 psi required by old CAR 3 regulations. Fuel tank vents were relocated beneath the wing, away from lightning strikes. Another safety improvement is the removal of the header tank, getting fuel out of the cockpit. The fuel tanks hold 25 gallons each in the three-point attitude, but only 22 gallons is documented as usable. The designation of three gallons of unusable fuel per tank helped streamline the certification process, but it's likely that you can use more than 22 gallons per tank, especially if you maintain coordinated flight.

"All numbers we publish are worst case numbers," emphasizes Jim. Take-offs are measured at full forward C.G. with the cruise prop, and stall speed is measured with the long prop (which makes a 4 mph difference). Likewise, the cruise speed assumes the large tires and prop. "We can assume the worst and still outperform competitors' optimistic numbers," says Jim confidently.

The standard 26 G Oregon Aero cloth seats can be upgraded to leather seats for \$1,995. Short people like me appreciate that both front and rear seats are adjustable fore and aft, and tall people appreciate that the seats have been moved back an inch or two overall to provide more legroom. The front seat folds for easy access to the baggage area, and the rear seat is removable without tools if you want to use the entire rear area for cargo.

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CUBCRAFTERS CC18-180 TOP CUB

BASE PRICE: \$159,500



CubCrafters TOP CUB is a two-place, conventional-gear bush airplane. Based on the Piper Super Cub design, this airplane features improvements making it an ideal backcountry performer.

SPECIFICATIONS

POWERPLANT	180-HP LYCOMING O-360-C4P
RECOMMENDED TBO	2,000 HR
PROPELLER	SENENICH 76-IN
	MCCAULEY 82-IN (OPTIONAL)
	WOOD SENENICH 80-IN (OPTIONAL)
	MODIFIED CLARK-Y
AIRFOIL	22 FT 6 IN
LENGTH	6 FT 7 IN
HEIGHT	35 FT 4 IN
WINGSPAN	178 SQ FT
WING AREA	12.92 LB/SQ FT
WING LOADING	12.8 LB/HP
POWER LOADING	TAILWHEEL
LANDING GEAR	2, TANDEM
SEATS	28 IN
CABIN WIDTH	46 IN
CABIN HEIGHT	1,200 LB
STD EMPTY WEIGHT	2,300 LB
MAXIMUM GROSS WEIGHT	2,300 LB
MAX GROSS WEIGH WITH FLOATS	1,100 LB
MAX USEFUL LOAD	750 LB WITH WIPLINE AMPHIB FLOATS
MAX USEFUL LOAD WITH FLOATS	800 LB
MAX PAYLOAD W/FULL FUEL	2,300 LB
MAXIMUM TAKEOFF WEIGHT	2,300 LB
MAXIMUM LANDING WEIGHT	50 TOTAL, 44 GAL USABLE
FUEL CAPACITY, STD	8 QT
OIL CAPACITY	210 LB
BAGGAGE CAPACITY	

PERFORMANCE

TAKEOFF GROUND-ROLL	580 FT WITH SENENICH CRUISE PROP
TAKEOFF OVER 50-FT OBSTACLE	1,000 FT WITH SENENICH CRUISE PROP
RATE OF CLIMB, SEA LEVEL	797 FPM WITH SENENICH CRUISE PROP AND 26-IN TIRES
MAX LEVEL SPEED, SEA LEVEL	140 MPH
CRUISE SPEED @ 75% @ 7000 FT	127 MPH
FUEL BURN @ 75%	9.5 GPH
FUEL CONSUMPTION (NORMAL)	7.5-8.5 GPH
ENDURANCE @ 75%	4.6 HR
MAX RANGE	715 SM PLUS
SERVICE CEILING	14,500 FT
LANDING OVER 50-FT OBSTACLE	975 FT
LANDING GROUND-ROLL	580 FT

LIMITING AND RECOMMENDED AIRSPEEDS (MPH)

V _X	60
V _Y	74
V _A	102
V _{NO}	133
V _{NE}	152
V _{S0}	48 WITH MCCAULEY PROP
V _{S1}	54 WITH MCCAULEY PROP

ALL SPECIFICATIONS ARE BASED ON MANUFACTURER'S CALCULATIONS. ALL PERFORMANCE FIGURES ARE BASED ON STANDARD DAY, STANDARD ATMOSPHERE, SEA LEVEL, GROSS WEIGHT CONDITIONS UNLESS OTHERWISE NOTED.

FOR MORE INFORMATION, CONTACT CUBCRAFTERS, INC., 1918 S. 16TH AVE., YAKIMA, WA 98903, (509) 248-9491, WWW.CUBCRAFTERS.COM.

Stock instrumentation includes basic VFR instruments, a turn coordinator, and VSI. Electronics International engine instrumentation is standard, including a digital OPT-1 Oil Pressure/Temperature Gauge, VA-1A Volt/Ammeter, a C-1P Cylinder Head Temperature Gauge, and an E-1P Exhaust Gas Temperature Gauge. Not only are these advanced instruments more accurate than the older instruments, there is no oil pressure line running into the cabin, eliminating the source of a possible oil leak. A JPI EDM-800 engine analyzer is also available as a \$3,995 option.

The TOP CUB comes in three versions. The Legend edition comes in the traditional Cub yellow, at a base price of \$159,500. The Ranger edition adds \$3,900 for the two-color, more modern paint scheme. Avionics packages range from \$9,975 for a Garmin GNC250XL GPS/COM, GTX327 Transponder with mode C, and PS Engineering PM 1000 two-place intercom, to more than \$35,000 if you opt for all the options. They include a deluxe IFR package with a Garmin GNC 530 GPS/NAV/COM, Garmin transponder, GMA340 audio panel/intercom, a GI-106A CDI, and a vacuum system with attitude indicator and DG; pilot and co-pilot Bose headsets and associated wiring; a Garmin GTX330 transponder upgrade with traffic information; and an AM/FM radio with CD/MP3 player. CubCrafters recently received certification for the Amphib edition on Wipline 2100 Amphibious Floats, which adds \$45,500. The McCauley 82-inch climb prop is required for this option. IFR Certification is anticipated in the spring of 2006.

Flying It

Lean manufacturing, a strengthened airframe, and vortex generators are great, but what really matters to me is, "How does it fly?" and the TOP CUB did not disappoint. When I mentioned to Jim that I enjoy backcountry and mountain flying, he was eager to show me that the bush is where the TOP CUB really shines.

Visibility is good for a taildragger. I usually need to S-turn when I taxi a tail-wheel airplane, but since the TOP CUB's nose is narrow, I could clearly see around it. Also, it's nice to have a symmetrical sight picture sitting at the centerline of the fuselage. True to its Super Cub origins, the TOP CUB is equipped with heel brakes. I'm used to toe brakes, so it felt awkward at first. However it became second nature after just a few landings.

With Jim and me, our weight was about 1,900 lbs., well below the 2,300-lb. gross weight. (Had I wanted to test the TOP CUB at gross weight, I would have had to load 200 lbs. of baggage, and find a 400-lb. rear seat passenger.) After pulling on one notch of flaps (22 degrees), and applying full power for takeoff, acceleration was brisk and the tail came up immediately. Torque



Left: The TOP CUB easily maneuvered through a tight slot in the trees to land at Tieton State Airstrip in Washington.

Below: The extended landing gear reduces takeoff distance.

Bottom: The standard vortex generators improve low-speed handling.

was minimal, so just a little right rudder kept me on the runway centerline.

As soon as the tail came up, Jim yelled, "rotate, rotate!" from the back. I pulled back and we leapt into the air. I had reacted too slowly for a maximum performance takeoff, hesitating a second or two, keeping the airplane on the ground until well after it was ready to fly. Unlike my Cessna 185, you don't pick up the tail, wait for speed to build, and then rotate. At weights around 2,000 lbs., you pick up the tail as soon as it feels light and then rotate immediately. With such technique, the airplane will lift off at about 45 mph with takeoff distances under 600 ft. at gross weight, and under 300 ft. at light weights. In fact, with a stiff crosswind, it would be easy to take off perpendicular to a wide runway.

I pitched to a Vy of 75 mph, and climbed out at an impressive deck angle as the VSI indicated more than 1,200 fpm. We had already climbed through pattern altitude by the time we passed the end of Yakima's



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7,600-ft. Runway 9/27. True to a Super Cub, the airplane is nimble and control forces are light. In fact, one experienced Super Cub pilot mentioned that she just loves to "strap a Cub on and go flying." And that's the best description; it really does feel like an extension of your body.

I reduced power to idle and pulled the airplane up into a 60-degree bank and

pulled hard. We turned on a dime, before the stall horn and slight burble gave us ample warning that I was beginning to push the limits. With a little more stick pressure, the TOP CUB stalled straight ahead with no unusual tendencies. Recovery was immediate. As soon as I let off the backpressure, the airplane recovered, still in a 60-degree bank.

A TOP CUB is an excellent low-speed performer and is quick to recover from a stall. Jim likes to demonstrate a straight-ahead stall with a little power. If you just ease off the stick a little, the airplane recovers with the nose up, and literally climbs out of the stall.

To try takeoffs and landings, Jim took me to the private 2,400-ft.-long West Valley Ranch airstrip. He explained the procedure to minimize trimming in the pattern: Reduce power to 1,200–1,500 RPM and let the airplane start to slow. When you realize you're holding the nose up (at about 70 mph), add the first notch of flaps and continue to slow down. When you again realize you're holding the nose up (at about 60 mph), add the second and last notch of flaps and start your descent. This way, you'll fly the entire pattern and approach with the same trim. Jim says he often sees even experienced pilots reduce speed, trim up, add flaps, trim down, reduce speed, trim up, then add flaps again and trim down again, not realizing that they just got back to where they started.

After reducing power, we stabilized in the pattern at 60 mph indicated with full flaps (two notches or 50 degrees). Control response was still crisp, and the airplane felt solid despite the low airspeed; I'm sure

WHAT REALLY MATTERS TO ME IS, "HOW DOES IT FLY?" AND THE TOP CUB DID NOT DISAPPOINT.



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IF YOU JUST EASE UP OFF THE STICK A LITTLE, THE AIRPLANE RECOVERS WITH THE NOSE UP, AND LITERALLY CLIMBS OUT OF THE STALL.

the VGs contributed to the responsiveness. Turning final, I slowly bled off speed until we crossed the fence at about 50 mph. There is about a 3% slope to the 35-ft.-wide strip, so when we touched down at under 40 mph, we had almost no rollout; we stopped in well under 500 ft. with minimal braking (I was still getting used to the heel brakes).

I taxied to the top of the strip, spun around, pointed the nose downhill, and applied full power. The takeoff roll was incredibly short, but I still didn't react fast enough for a maximum performance takeoff. Jim kept emphasizing that I could have lifted off far earlier than I did.

After just a few takeoffs and landings, I became comfortable with the airplane, and was operating the stick and the heel brakes with ease; unfortunately it was time to head back to Yakima. We climbed to 3,000 ft. and powered up to 2,600 RPM on the way home. The airspeed settled in at about 105 mph with the climb prop, which yielded about 110 mph true airspeed. CubCrafters advertises a 112 mph speed at 65% power with the cruise prop, and 127 mph true airspeed at 75% power. At cruise, the TOP CUB burns between 7 and 9 gallons per hour. With today's fuel prices, I would welcome the lower operating costs.

Back at Yakima, I made a wheel landing, and bounced a little. I would like to think that it was due to the stiff, three-inch longer gear, but it was probably my sloppy technique. I wanted to go back and try it again. And again. And again. In fact, I did not want to relinquish the controls, but the sun was getting low on the horizon. The TOP CUB is a fun airplane to fly with spectacular short/soft field performance. It doesn't demand much of the pilot. You can just about load anything you want and still fly under gross. It'll take off and land in 500 ft. or less at most weights, and there aren't many strips in the country that are shorter than that.

My only regret is that my test flight was from Yakima to a private strip 10 nm away. If I had it to do all over again, I would have test flown the TOP CUB to the Idaho backcountry, British Columbia, or Alaska with a load of camping gear to test out its load hauling abilities. Oh, a couple of hours on the new amphibians wouldn't have hurt either. ■

TOP CUB MODS

At a recent CubCrafters fly-in, an experienced Alaskan bush pilot commented that, years ago, his company would make 40 modifications to factory-new Piper Super Cubs to make them "bushworthy." He discovered most of the mods are already included in the TOP CUB. There are too many enhancements to list, but here are the main ones:

Mods that would require an STC on a Super Cub

- Vortex Generators
- 180-hp engine
- 50-gallon fuel capacity
- Rear mounted oil cooler
- Fiberglass split cowl
- Stainless steel exhaust with crossover & slip joints built in
- Three-inch extended landing gear legs
- Wide, four-leaf tail spring
- Heavy-duty, two-hole tailwheel assembly (from Pawnee)
- Square instrument panel with "floating" sub panel
- High-pressure booster master brake cylinders & brake lines
- Extended baggage compartment
- Outside baggage door
- Fueling Steps
- Swinging rear seat crossbar
- Hinged front seat
- 180-lb. cargo compartment
- Electronics International engine instrumentation

Common Super Cub mods for which there is no STC (usually installed with field approvals)

- Under rear seat storage compartment
- X-brace under the skylight
- Tinted windows and skylight (gray)
- Metal headliner for durable cargo storage
- Fuselage reinforcements
- Functional upper door latch

Mods for which there is no comparable Super Cub Mod available

- 2,300-lb. gross weight
- Extended CG range, 75–81 inches
- Upper baggage compartment
- Battery relocated above headliner
- 11 cargo tiedown hooks
- 26G adjustable front seat
- 21G adjustable rear seat
- Tri-belt seatbelt system with inertia reels
- 2024T3 Leading edge skins for dent resistance and light weight
- Emergency outside door handle