TEXAS STOL ROUNDUP

Presents

S.T.O.L. Operations©

by

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The acronym S.T.O.L., which stands for Short Take Off and Landing, conjures up images of all sorts of aircraft modifications in most pilots' minds. Leading edge cuffs, stall fences, vortex generators, drooping ailerons and so on are all aircraft modifications intended, or at least claimed, to have near magical effect on the short field capabilities of an airplane. Having flown aircraft equipped with many of these modifications, I can attest to the fact that most of them do have some noticeable effect on the performance of the aircraft, and some have quite a lot of influence on the manner in which the subject aircraft performs in the slow speed end of its flight envelope.

The most effective STOL "kit" available though, is not installed by a mechanic. The single most important factor contributing to the safe operation of an aircraft in the short field environment is the skill and knowledge of the pilot, not the number of gadgets attached to the airplane.

So, what are the magic skills possessed by the heroes of the horizon, those bush pilots of renown? And how do we mere mortals learn their techniques, so that we too can safely operate our aircraft from a postage stamp size strip? For the most part, these techniques are simple: absolute adherence to basic piloting skills which we all should have learned in our earliest flight training and a fanaticism for precision.

The task before us in the short field landing is really pretty simple: Touch down at a specific point, with the airplane at minimum safe forward speed, and at the minimum possible weight, followed by application of maximum braking. Steering comes in there somewhere, too, but these are the real priorities for short (as opposed to narrow) field operations. This is an exercise in physics, folks: mass times velocity equals inertia. Minimizing the inertia at touchdown, then dissipating it in the minimum amount of space is the name of the game for short field operations.

To start with, I usually try to fly a rectangular (or modified rectangular) traffic pattern to a short field landing. There are a lot of good reasons to fly a rectangular pattern, it helps to gauge our progress in the descent, and gives us perspective of the landing area. Remember, though, the pattern altitude in an off-airport setting doesn't have to be 800 feet above the surface, and the pilot should keep the patterns close in to the intended landing site.

Airspeed control throughout the approach is critical. An old saying has it that it is next to impossible to turn a bad approach into a good landing. Airspeed on short final is even more critical in the short field venue. Too much speed and the airplane will float well past the intended landing point; too little speed, and we may land a bit short of the "airport", and have to walk home. So, what airspeed to use on short final? Obviously, the specific airspeed for each model of airplane will be somewhat different, so all we can do here is develop some basic guidelines. The FAA advocates 1.3 Vso (one and one third times the power off stall speed with flaps deployed) in its practical test standards for approaches. While 1.3 Vso offers a comfortable margin in a normal landing approach, and it works fine on downwind to a short field, it won't work on final in this environment. I use an approach characterized by different speeds on different portions of the approach. Downwind and base leg may be flown at a relatively fast 1.3 Vso, while short final will be flown at somewhere very close to Vso and the speed at touchdown will be even slower. This offers a lot of margin on the initial portion of the approach, yet minimum forward speed at touchdown. Remember that most airspeed systems on our aircraft aren't very accurate at very high angles of attack, so this should all be practiced at a safe altitude, with a competent instructor, until you have a really good FEEL for the airplane in this configuration, and know what all the indications are at minimum controllable airspeed. If your airplane has been modified, the pilot operating handbook may not offer very accurate information on the actual stall speed of your airplane. On the other hand, DO NOT take the performance claims of the manufacturers of the various STOL devices as gospel. Every airplane, and every pitot static system is a bit different. Find out for yourself, at a safe altitude, what minimum controllable airspeed is, and what the stall characteristics are for your airplane. Again, the assistance of a competent instructor, experienced in your aircraft type, is invaluable in this process.

Short field approaches will often entail a fairly flat approach, and the use of some power. Power helps manage our descent rate, and the use of some power reduces the stall speed of the airplane significantly. For example, the power off stall speed of the Aviat Model A-1 Husky is given as 43 mph by the pilot operating handbook, while the power on stall speed is 37 mph (this is actual flight test data). The propeller slipstream keeps the airflow attached to the inboard portion of the wings and tail surfaces, permitting the airplane to fly at slower speeds. By using power, we can take advantage of a slower approach speed, while still maintaining a safe margin above the stall. Remember the physics: mass times velocity…. Our task here is to arrive at the touchdown point at minimum SAFE forward speed.

As the airplane touches down (precisely on the intended touchdown point, of course) the throttle comes back to idle, and the airplane should be all done flying. The idea here is to slow the airplane to below power off stall speed precisely at the moment of touchdown. This is what pilots are referring to when they speak of "hanging it on the prop", and while at first blush, this seems like a bit of a daredevil operation, it really isn't when properly carried off. In many aircraft, you will be operating in the "region of reversed command" (or "behind the power curve"), where the only way to climb is to lower the airplane's nose, something to keep in mind if a go-around becomes necessary.

In a tailwheel airplane, I favor touching down very tail low, with the tailwheel a couple of inches off the ground, and at the first touch, roll the airplane up onto its main wheels. This places the maximum weight on the main wheels, permitting maximum braking effectiveness. In a tricycle gear airplane, this all tends to take care of itself by holding the nose wheel off as long as possible. As soon as possible, retract the flaps, again to maximize braking effectiveness. In one of my favorite venues-floatplanes, raising the nose while retracting the flaps offers awesome deceleration, and very short landings. However, the approach techniques are the same regardless of whether your airplane is equipped with wheels, floats or skis. Once again, these are techniques which should be practiced extensively at a safe altitude and at least initially with a competent instructor.

We must practice, practice, and practice our approaches some more so that every touchdown is precisely on the spot we have chosen, with the airplane at target touchdown airspeed. This practice needn't be done on a gravel bar somewhere in the bush. A can of surveyor's spray paint (the kind that works upside down) can be used to mark off a touchdown box on a lightly used uncontrolled airfield. Make the box about ten feet wide and ten feet long (or however small you feel up for), and locate it a safe distance from the actual approach end of the runway in use. Again, initially with a competent instructor, start working on that precision until you can touch down ***in*** the box ***every*** time, at minimum forward speed. Once you can consistently do so, you are well on your way to successful short field operations. Now, practice some more. Accept nothing less than perfection here.

Any short field approach which is not working out ***precisely as planned*** should be abandoned, and a go-around initiated as early as possible. The pilot should always be prepared to initiate a go-around-unless, of course, you are operating into one way strips. Landings on short one way strips are sort of like sky diving—they really need to be pretty much perfect the first time.

Most of us don't get to perform a large number of landings, and since short field landings demand the utmost skill and practice, I contend that we should make nearly ***every*** landing and takeoff a maximum short field operation, unless conditions (such as very gusty crosswinds) dictate otherwise. Even if you are landing on a ten thousand foot runway, choose a touchdown point on the runway, set up a short field approach to that point, and do your best to land on the point, and stop as short as possible. Performing this maneuver at the very approach end of the runway, with three thousand feet of runway ahead of you to the next taxiway may not endear you to ATC, so you might want to choose a landing zone near a taxiway.

Now that we have managed to insert our airplane into this small version of an airport, how are we going to safely get it out of here? First, we need to be familiar with the climb characteristics of our airplane. Many aircraft have been so extensively modified that the numbers offered in the pilot operating handbook aren't even a very good starting point. There are formulas which will derive theoretical best angle and best rate climb speeds, but you need to practice anyway, so why not turn your practice sessions into an effort to determine the best climb speeds for your airplane? Start with the factory recommended airspeeds, then experiment with other speeds and configurations, using timing and altitude to derive best rate and time over a known distance to determine best angle. Remember that weight of the airplane has a dramatic effect on best climb speeds—the lighter the plane, the slower the climb speed for maximum performance. And, not only do we need to determine the best angle of climb speed, but also the configuration in which that speed will achieve the best angle of climb. Figures given in the pilot operating handbook for most aircraft are numbers for the airplane at gross weight, unless otherwise specified.

Some of these numbers and configurations can seem sort of scary. For example, the Super Cub handbook recommends a best angle of climb speed of 45 mph, with full flaps. If the engine fails in that configuration, you will note some interesting pitch changes, to put it mildly. Nonetheless, this is the speed at which the manufacturer recommends you depart for maximum obstacle clearance, assuming an aircraft weight of 1750 pounds. Been operating your Cub a bit over 1750 (with a Wipaire STC, of course)? Don't ask me what the best angle of climb is, you will have to determine that yourself. This should be done at a safe altitude and with the assistance of an instructor to assist from both a safety standpoint, and to help keep track of data. Just remember that if you are deviating either up or down from the weight used by the manufacturer to determine best climb speed, the speed will also change.

Holding the airplane's brakes prior to takeoff while applying takeoff power may be a reasonable short field technique on paved surfaces, but if you value your propeller, holding the brakes while running up a lot of power on a gravel strip is a bad idea. Besides, most paved runways aren't really very short, either. A rolling acceleration, with power gradually but steadily applied, will serve well on most short strips, while keeping your propeller serviceable.

I prefer a tail low takeoff technique, with the tailwheel just off the ground, but again, it is important to understand what the manufacturer recommends for your aircraft. At first, allow the airplane to simply fly off when it is ready. In this case, we set the flaps prior to starting the takeoff roll. Some pilots prefer to start the takeoff run with flaps up, then add flaps only after they are rolling at near takeoff speed. This may assist the initial acceleration (the theory being that the flaps initially create drag). But, when one first starts working on these techniques at least, fiddling with flaps is a distraction I would do without during this critical phase of flight. Again, we need to ensure consistency, as well as performance, so I don't advocate a technique that requires a great deal of finesse, and is easy to botch, at least not until you are confident that you can perform the technique flawlessly every time. So, if you are going to "pop" flaps for takeoff, practice, practice, practice this technique.

From your private pilot lessons, you may recall that after a short field takeoff, you should accelerate to Vx, or best angle of climb speed, until all obstacles are cleared, then accelerate to Vy, or best rate of climb. This all works well in my book, and I would add little to this, except to note that if you do not have to clear any obstacles, you may just as well accelerate directly to Vy. Remember, unlike in our private pilot training days, the task isn't to clear an imaginary 50 foot obstacle, it is to clear a very real obstacle of undetermined height. I often tell my students that all you have to do is clear the obstacle, you don't have to clear it by 200 feet. The message? Don't operate the airplane at very slow speeds in the climb (Vx) unless you really need to. I would rather climb over the obstacle at a slightly lower height, with a bit of extra airspeed.

The second "free" STOL kit we can install in our airplane is actually something we take out of the airplane. If you talk to any number of pilots who regularly operate in and out of short fields, they will consistently tell you that to operate into truly small spaces, you simply will not be able to operate the airplane at gross weight. This applies to landings as well as takeoffs, by the way. I have heard a lot of pilots who refer to "going in heavy and coming out light". While this may work on a given landing site, it doesn't necessarily mean that the airplane will be at gross weight during either the landing or the takeoff. Again, remember the physics: Mass times velocity equals inertia. Once the airplane is on the ground, braking is all we have left to stop it. The lighter the airplane is when it touches down, the less braking required to stop it.

Here's a news flash for you Super Cub drivers: The stall speed listed by Piper for the PA-18, at 1750 pounds gross weight, is 42 or 43 mph, depending on which model you have. Wipaire has certified an STC to increase the gross weight of the Super Cub to 2000 pounds. The new stall speed listed in the Wipaire supplement for the Cub at 2000 pounds is 53 mph. The original Aviat Husky A-1 had a stall speed of 43 mph at 1800 pounds, but the newest Husky-the A-1B, has a stall speed of 54 mph at 2000 pounds. Aerodynamically, the lighter gross weight version of these airplanes does not differ from the heavier version-they are aerodynamically identical. Only structures and weights are different, but what a difference a few hundred pounds makes! This should be a lesson for us all.

Keep this in mind when you are preparing to fly out to that backcountry strip. Can't survive out there without all your "stuff"? Make two trips. Or three. I recall several years ago watching an air taxi operator with a Super Cub ferrying hunters to ridge tops in the Alaska Range from a larger strip where the hunters were dropped by a Cessna. Every other trip, the pilot filled a 2.5 gallon can with gas, and added it to the airplane. That pilot knew the capability of his airplane, and understood that the lighter the airplane is, the shorter the required runway. Just don't make the mistake that many pilots have in Alaska, which is to load the airplane to (or well over) gross weight, and then expect it to perform. It won't, and hanging another device on the leading edge isn't the best solution to this problem.

Next, and this is a big one: Understand the effects of Density Altitude. Density altitude robs your airplane engine of power, and your wings have to be accelerated to a higher velocity to make lift. If you're going to operate in a high density altitude environment, find a density altitude chart on the internet, and study it…..maybe laminate it and keep it in your airplane. Remember, high density altitude doesn't change the indicated airspeed you'll use for various evolutions, but your ground speeds will be significantly higher. This means that your landing and takeoff distances are going to increase, often significantly.

Now that I have beleaguered you with the notion that the pilot is the real key to effective short field operations, here are a few "STOL modifications" you can apply to your airplane which will absolutely, positively, produce shorter takeoffs and landings, assuming proper pilot technique:

Install a lightweight starter—weight savings: 10 pounds or more

Install a dry cell battery, and shorten the cable runs by moving the battery as far forward as possible—weight savings: 10 to 15 pounds.

Remove all that wiring, plumbing, and equipment that hasn't done anything in your airplane for years. You would be surprised at how much old wiring adds up, weight wise.

And, finally, the toughest one of all: lose a few pounds off the pilot. Hey, it'll not only improve the performance of your airplane, but it will keep you flying longer by improving your chances of passing your next flight physical.

So, the keys to short field operations are:

1. Practice until you can precisely place your aircraft where you want it every single time, at minimum safe airspeed.
2. Keep the airplane light, both for landings and takeoffs. Make two or three trips if necessary.
3. Always be prepared for a go-around if necessary.
4. Determine and commit to memory the best speeds for your airplane, and practice climbs and descents at these speeds regularly to maintain proficiency and familiarity.

That's all there is to it, folks. Sounds simple doesn't it? And it is—just takes a little focus and determination. As well as a good bit of skill and lots of practice.

Safe flying to you!