SAFETY GRAM 4.0

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Air Force Aero Clubs,

A few weeks ago I was accomplishing a currency flight with an instructor with the intention of going out to our local practice area and working on some commercial maneuvers. I wasn't expecting the instructor to simulate an engine failure after takeoff. I honestly was caught by complete surprise. I was able to manage the situation and talked through what my actions would have been had it really happened, but it really made me think about my preparation for an event like this for the next time I fly.

The first thing a pilot should be concerned with if this happened on takeoff is ensuring the aircraft continues flying. When you lose your engine shortly after takeoff the aircraft is already dangerously close to stalling, so ensuring you pitch for the appropriate airspeed listed in you aircraft flight manual is essential. Second is figuring out where you can put the aircraft safely back on the ground. There are a lot of factors like altitude, terrain, airport layout, etc. that go into determining that. It is also something that should be thought about and briefed prior to flight so if it really happens you are just executing what you already planned. In my scenario there was a cross runway I would have been able to safely turn to and land on, but that isn't always the case. Depending on your altitude careful considerations and caution should be made in making an aggressive turn back to pavement because it may put you in a much worse situation than finding an acceptable place to land straight ahead.

I have attached two articles covering some more details on engine failures after takeoff and considerations pilots should have had when experiencing one. Use them as a primer to hold your own discussions locally at each Aero Club.

Fly Safely,

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Engine Out on Takeoff

An engine failure on takeoff will take you by surprise, so be spring-loaded for action.

By **estaff** - **Published:** July 27, 2002 **Updated:** October 29, 2019

Once upon a time, I experienced two engine failures on takeoff on the same day, in the same airplane, on consecutive flights. I showed up early in the morning to teach soaring, and the schedule for the day was pretty full.

My favorite aircraft at the field, a J-3 Cub, had undergone some maintenance on the previous day and needed a test flight before returning to service. It was my joy to have a quiet morning to myself on the grass airstrip before the day turned busy. The mechanic had signed off the aircraft logs on the previous night and I didnt find any items on the preflight of concern. After the preflight, I hand propped the engine, climbed in, taxied out and took off.

I was completely unprepared for what happened next. The engine failed at about 100 feet. It happened so fast that I could barely react. It was all I could do to prevent an instant stall/mush.

I lowered the nose to maintain airspeed and made what no one would mistake for a nice three-point landing. I walked the airplane back to the hangar, talked with the mechanic and sat there while he tried to figure out the problem. After an hour of trouble-shooting, he found nothing.

We restarted the engine and it fired right up. We ran it for a while, ran the engine up to takeoff rpm and it still ran perfectly. We couldnt figure it out. The mechanic signed it off and, since it still needed a test flight, I chose to give it another try.

Unbelievably, the engine failed at the same place on the takeoff as it had earlier. This time I was better prepared for the event and lowered the nose more quickly for a landing. It still wasnt my best landing attempt in the gentle Cub.

It turned out the problem was fuel starvation. The J-3 Cubs fuel tank indicator is little more than a coat hanger sitting on top of a cork. The bobber pops up in plain sight, right in front of the pilots eyes. The coat hanger had been replaced, but the new one was too long. The indication that had always meant a half-full tank of fuel was now a near-empty tank. When I rotated for takeoff, the fuel pick-up at the front of the fuel tank unported, thus inducing a loss of power.

In addition to my own actual engine failures on takeoff, I had the unfortunate circumstance of watching a fatal engine failure on takeoff one day while flight instructing. I cant remember why I took the student up to the observation platform, but there we stood when suddenly a Cessna 182 climbing through what seemed to be 800 feet agl dropped a wing and plummeted to the ground. The engine failure, your shock, and the rapid loss of airspeed and altitude all seem to happen with lightning speed.

Nose in the Air

Engine failures on takeoff are especially dangerous events and are very unlike the simulated engine failures at altitude. For starters, the aircraft is close to the ground with little margin for error rather than at altitude and cruise speed, as is most commonly simulated.

At takeoff, the aircraft might have some extra drag due to the flaps or perhaps the gear still hanging down. The aircrafts airspeed is close to the bottom of the flight envelope and, with the nose high for the initial climb, the airspeed promptly plummets when the engine fails. Because of this, the aircraft is going to drop like a rock. If you botch the recovery from an engine failure on takeoff, you could be dead in two seconds.

Compare this with the relatively benign simulated engine failure at altitude. The usual scenario includes enough altitude to set up a nice glide, pick out a field and work on resolving the failure.

The aircrafts attitude is relatively flat, so the nose is close to the horizon. That makes it easy to set up the glide.

You have plenty of airspeed to bleed off while setting up the glide. The aircraft is probably in the clean configuration so it wont bleed off the airspeed as fast. If you happen to get a bit slow during the glide, the only practical immediate effect will be a penalty to your glide performance.

There are two additional major differences between simulated engine failures and the real thing. During a simulated engine failure in a single, the propeller is still producing thrust. Its comparatively small, but anyone who has flown a floatplane or one on skis knows how much thrust is actually created by idle power.

When an engine actually fails, the propeller is no longer being driven by the engine and is no longer producing thrust. Instead, the airflow is turning the prop, which is fighting engine compression – and this creates a large amount of drag.

The proof of this can easily be demonstrated in a multi-engine airplane that has feathering props. Kill an engine with the prop pitch flat, and the adverse yaw is much more pronounced than with the prop feathered. This is one reason that the airspeed seems to instantly drop at the moment of engine failure. The drag on the aircraft due to a windmilling propeller is substantial.

Second, simulating an engine failure at altitude gives you the benefit of a nice horizon to use as a reference for maintaining pitch control. A failure on takeoff, however, doesnt lend itself to using the horizon. Local geography can make visual references misleading. In addition, many pilots follow their training by dropping the nose, but neglect to consider the nose-high attitude the airplane initially had. The nose really needs to be very low with respect to the horizon.

The real differences in these scenarios became more obvious to me when I studied the spin accidents in the NTSB database. Forty-eight serious or fatal spin accidents occurred when the engine failed on takeoff. All of these occurred at less than 250 feet agl, where there is no margin for error and insufficient altitude for a spin recovery.

Maintain Aircraft Control

The most important task you must do during any emergency is to maintain aircraft control. This can be surprisingly challenging, even if you think youre prepared for it.

You simply cant believe the disbelief when the engine suddenly fails, nor how fast the airspeed and altitude decay. When this happened to me, I had about 3,000 hours total time and had been actively flight instructing for years before that. In fact, I had been inducing a similar failure (rope breaks) to soaring students.

It was a maneuver that I had simulated in a training situation many times, but it still didnt prepare me for the shock. I had been thoroughly ingrained with the primary task of maintaining aircraft control, but if you really want to know the truth, my performance was poor.

I barely lowered the nose enough to maintain a flyable airspeed and was very close to stalling. I really needed to lower the nose more.

During takeoff in a general aviation aircraft, your pitch attitude is about five degrees above the horizon. When the engine fails, you need to lower the nose immediately to maintain a sufficient flying airspeed. In cruise-flight engine-out training, you immediately drop the nose five to 10 degrees below the horizon or watch airspeed bleed off.

In a takeoff situation, with the airspeed slow and the nose already five degrees up, you need to promptly drop the nose 10 to 15 degrees or more to keep the airspeed out of stall territory. That takes more nose-down control input than you may be ready for, especially close to the ground.

Try this some time: Simulate an engine failure on takeoff at a safe altitude. Hold the airplane at rotation speed, apply takeoff power, establish a climb pitch attitude, and then abruptly retard the power. If you keep the nose up for the slightest hesitation, you will be impressed at the lightning quick decay of the airspeed.

Preventing the Engine Failure
Ideally, the most effective method to prevent an accident from ever happening is to break the error chain before the accident occurs. Of the 48 fatal engine-out takeoff accidents I studied, 31 were the result of an actual mechanical failure.

Good maintenance may be expensive, but bad maintenance is much more expensive. Some of the mechanical failures could have been caught with a sufficient run-up and before takeoff check.

Several pilots attempted to takeoff with insufficient time for the oil temperature to rise during cold weather operations. Their engines seized due to lack of oil lubrication during the takeoff roll. Some took off and had oil filters fall off, right after the engine had undergone an oil change. Their engines didnt run very long through the takeoff before the engine suffered oil exhaustion.

There is no substitute for a thorough preflight, especially after coming out of maintenance, and a methodical taxi and before-takeoff check to bring the engine up to temperature and ensure that it is operating smoothly.

Mechanical failures can be reduced through periodic preventive maintenance but some failures will always happen. Some of the pilot errors, however, are difficult to dismiss. Ten of the accidents were due to mismanaging the fuel selector, including selecting the off position or choosing an empty tank.

Some of the problems occurred at flight schools, where the procedure was to shut off the fuel at the end of a flight to make sure the next student checked it. In several accidents there was enough fuel to start the engine, taxi and attempt to take off.

Five accidents were due to the fuel being contaminated by water. In the big picture, it barely contributes to the overall accident rate, but its still easily prevented. Most of these occurred to aircraft that sat outside during previous heavy rainfall.

Some fuel cap designs allow rainfall to puddle around the fuel cap and then leak into the fuel tank. If fuel contamination has occurred, sumping the tanks as part of a thorough pre-flight inspection is the last chance to catch the contamination.

The Brief

Before each flight in a two-pilot aircraft, the crew briefing is extensive. It goes something like this. Im going to advance the power levers. Id like you to check for two good engines. Id like the standard call-outs such as power set, two good engines, airspeed alive, eighty knots, checked. If you see any problems up through 80 knots, I want you to call out abort, abort, abort. Between 80 knots and the takeoff decision speed, well abort for any fire, engine failure or loss of directional control. Past the takeoff decision speed, well take any further problems as an inflight emergency, with no actions below 400 feet except to silence the bell. At 400 feet, well verify the failure then perform the critical action items. At a safe maneuvering altitude, well do the remaining clean up items, stay in a left-hand pattern and coordinate with ATC for a VFR landing on the longest runway into the wind.

This brief assumes the weather is VFR and we can return to the field. If the field is IFR or has an IFR departure procedure, well amend the briefing as needed. This sets a clear procedure on our actions in case of an engine failure. Of course this is predicated upon having a twin-engine aircraft.

So does it apply to single-engine, single-pilot operations? Im going to suggest it does.

I would amend a takeoff briefing for a single-engine aircraft to roughly follow this example. Ill advance the throttle while standing on the brakes and check for a good engine. If anything doesnt look or sound right at any time, Im going to abort straight ahead on the runway. If the engine fails once Im airborne, Ill lower the nose and land straight ahead in the cow pasture, wheat field, golf course, etc. If the engine fails, I will NOT make a turn unless I have at least a thousand feet.

The 1,000 feet figure is a suggestion, and should be modified depending on your currency, your aircraft and the surrounding terrain. Much has been said and written about the impossible turn scenarios, and only a practiced pilot using correct technique will be able to successfully make the turn in much less than 1,000 feet.

Speaking of the impossible turn, more than a dozen pilots in my stall/spin study tried turning back to the airport when the engine failed. None of them survived. An engine failure at 200 or 300 feet leaves no room for a spin recovery.

Its far better to prevent the engine failure through sound maintenance, ensure proper engine operation during the preflight and taxi by applying sound operating procedures and checks, and then brief yourself for the emergency. Know where you are going to land when (not if) the engine fails.

Be prepared so the instant this happens, youre ready to react.

Engine Failure After Takeoff (Single-Engine)

FILED UNDER: EMERGENCY PROCEDURES

The altitude available is, in many ways, the controlling factor in the successful accomplishment of an emergency landing. If an actual engine failure should occur immediately after takeoff and before a safe maneuvering altitude is attained, it is usually inadvisable to attempt to turn back to the field from where the takeoff was made. Instead, it is safer to immediately establish the proper glide attitude, and select a field directly ahead or slightly too either side of the takeoff path.

Flight Literacy Recommends

Rod Machado's Handling In-Flight Emergencies – Can you handle an in-flight emergency? This course trains you to do so. Shows in-flight demonstrations of many emergency procedures. This six-hour course also contains questions to test your knowledge to ensure that you retain the material.

The decision to continue straight ahead is often difficult to make unless the problems involved in attempting to turn back are seriously considered. In the first place, the takeoff was in all probability made into the wind. To get back to the takeoff field, a downwind turn must be made. This increases the groundspeed and rushes the pilot even more in the performance of procedures and in planning the landing approach. Secondly, the airplane is losing considerable altitude during the turn and might still be in a bank when the ground is contacted, resulting in the airplane cartwheeling (which would be a catastrophe for the occupants, as well as the airplane). After turning downwind, the apparent increase in groundspeed could mislead the pilot into attempting to prematurely slow down the airplane and cause it to stall. On the other hand, continuing straight ahead or making a slight turn allows the pilot more time to establish a safe landing attitude, and the landing can be made as slowly as possible, but more importantly, the airplane can be landed while under control.

Concerning the subject of turning back to the runway following an engine failure on takeoff, the pilot should determine the minimum altitude an attempt of such a maneuver should be made in a particular airplane. Experimentation at a safe altitude should give the pilot an approximation of height lost in a descending 180° turn at idle power. By adding a safety factor of about 25 percent, the pilot should arrive at a practical decision height. The ability to make a 180° turn does not necessarily mean that the departure runway can be reached in a power-off glide; this depends on the wind, the distance traveled during the climb, the height reached, and the glide distance of the airplane without power. The pilot should also remember that a turn back to the departure runway may in fact require more than a 180° change in direction.

Consider the following example of an airplane which has taken off and climbed to an altitude of 300 feet above ground level (AGL) when the engine fails. [Figure 17-5] After a typical 4 second reaction time, the pilot elects to turn back to the runway. Using a standard rate (3° change in direction per second) turn, it takes 1 minute to turn 180°. At a glide speed of 65 knots, the radius of the turn is 2,100 feet, so at the completion of the turn, the airplane is 4,200 feet to one side of the runway. The pilot must turn another 45° to head the airplane toward the runway. By this time, the total change in direction is 225° equating to 75 seconds plus the 4 second reaction time. If the airplane in a poweroff glide descends at approximately 1,000 fpm, it has descended 1,316, feet placing it 1,016 feet below the runway.

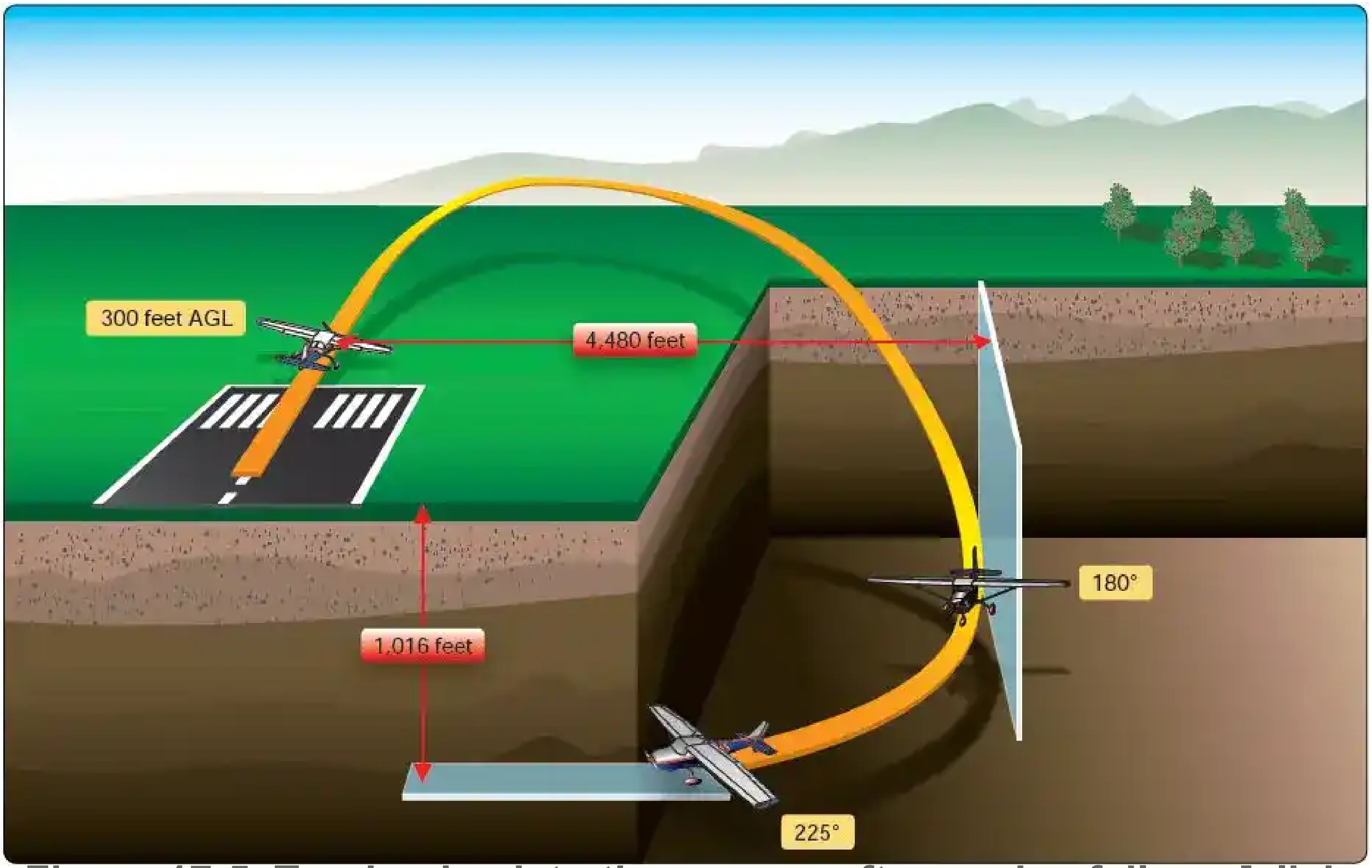

Figure 17-5. Turning back to the runway after engine failure. [click image to enlarge]