



Off Airport Landings

A guide on survival preparedness

eBook



Introduction

Lightspeed Aviation is proud to bring this compilation of important safety information to you — authored by pilots for pilots, passengers, and the general aviation community. For several months, we've been curating and creating content on the topic of surviving after an off airport landing. As pilots, we are trained how to fly through the crash to land as safely as possible. But we may be miles from nowhere. *Now what?*

Often the landing site can be in a place where search and rescue can take hours, if not days, to get to. So, would you be prepared for that part of "Now, what?". This eBook provides guidance and suggestions from experts and fellow pilots about what you should carry with you in an aviation survival kit, how to choose the best location and terrain in that emergency off airport landing scenario, and what technical equipment you should have with you to aid SAR in expediting your extraction.



About Lightspeed Aviation

Lightspeed Aviation, the leader in wearable ANR technology for pilots, operates with a simple strategy: know your customer well and remain committed to relentless product evolution. At Lightspeed, everything we do is in service to our customer and our products push performance to the edge of technological possibilities.

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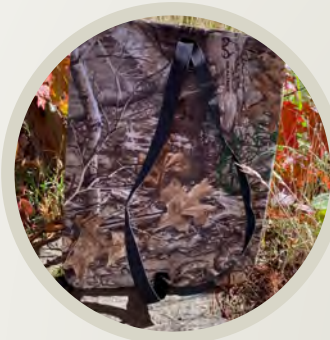
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The kit I assembled was designed assuming the conditions of a summer landing in the Coast or Cascade mountain ranges, and it all fits comfortably in a regular backpack (except for the floating cushion).

Floating cushion

Weighs almost nothing and has multiple uses: protection from the yoke during impact, thermal protection, seating pad for ground, and even a flotation device in the event a creek or river crossing.



Warm layers

Water resistant jacket with hood, baseball cap. (Winter conditions would require warmer clothing.)



Flight bag essentials

In my flight bag I always have back up battery packs for phone, iPad, and a transceiver; AA batteries; multiple flashlights; wool gloves.



Medical supplies

First aid tape, Neosporin, antiseptic wipes, sunscreen, clotting sponge, bug bracelet, Tylenol, band aids, lip balm



Fire, Shelter, Signaling

Plastic tarp, Survival sleeping bags, duct tape, work gloves, reading glasses, hand sanitizer, whistle, signaling mirror, waterproof matches, headlamp, shovel, fixed blade knife



Food and water

Plastic water bottles, one metal container suitable for use over a fire, water purification tablets, high energy and delicious (for morale) snacks



18-pocket vest

Recognizing there is a possibility the plane can be damaged in such a way that retrieving the backpack may not be possible, I also wear a nifty 18 pocket vest stuffed with the most crucial items on me and the multi-function paracord bracelet so that when my passengers and I evacuate the aircraft, we have the bare minimum to survive.



One more thing I never take off without: **The will to survive**. There is no photo for this one, but many experts agree that this is a factor that can affect the eventual outcome the most. It seems like the best advice is to keep a positive attitude, plan your activities, and maintain determination.

Below are some of the resources I found particularly helpful. Please share any others you have found, and if you have experienced a survival situation or participated in a realistic survival course. Please help us add to the knowledge on this important and neglected topic and make us all safer pilots!

Additional resources

(I have loaded many of these into my documents folder in ForeFlight)

- [CAMI 72 page survival training course for aviators](#)
- [FAA YouTube series on Aircrew survival in various scenarios](#)
- [AOPA Air Safety institute](#)
- [Handy guide by Bear Grylls](#)
- **FAR's for overwater and Alaska backcountry:**
 - [AS 02.35.110. Emergency Rations and Equipment](#)
 - [FAR 91.509 Survival equipment for overwater operations](#)



About the Author

Teresa De Mers is the Executive Vice President of Lightspeed Aviation responsible for Marketing and Corporate Development, and is a member of the company's board of directors. She has a Commercial certificate and an instrument rating and loves flying small airplanes and the freedom that general aviation provides. You will often see her at small airports in the Northwest enjoying the \$100 hamburger or pancake breakfast, and at aviation events all over the world engaging with fellow pilots and customers. She is passionate about aviation and ensuring that we share this precious endeavor with future generations.

Off Airport Landings – Choosing the Right Spot and Enhancing Survivability



So you have done your job as a pilot and prepared for the worst by staying proficient in power-off landings, by having a well thought out survival kit, and by learning some basic survival skills. Good preparation, of course, involves a bit more.

A secure cockpit is important: loose items will become projectiles in the event of a crash. You won't have time to stow things after the engine quits, so have all in-cockpit items properly stowed every time you fly. With regard to route planning, resist the urge to fly direct point-to-point over inhospitable terrain. Use a dogleg approach with your route planning and maximize your chance of a safe outcome by trying to stay near population centers and landable terrain. The risk of direct flight over rough terrain in the event of a power loss is not worth the potential time savings. Assume the engine is going to quit with all aspects of your flying AND planning.



In this piece, we will begin by discussing the basic things to consider when selecting an off airport landing site and the basic challenges posed by landing on various types of terrain. We will then move into a discussion about enhancing the survivability of a crash when the landing choices are "less than ideal" and conclude with a summary of sources for more information.

Here is a stretch of I-80 in Truckee, CA – the Sierra Nevada mountains. It is a good piece of asphalt and may be an attractive off airport site. . . .



...but beware the hazards as we zoom in: overcrossings and power lines.

Selecting a Spot – the Basics

So, when the engine does quit, the most basic choice is whether to choose a road or a field. I'll try to address this by describing some of the hazards and pitfalls of each.

Let's begin with roads – they are tempting because they are like hard surface runways. Unfortunately, roads present a series of problems because they are not runways and were not designed with aircraft in mind. To begin with, even if the road is straight, most are quite narrow and therefore require some extra landing precision under a stressful situation. In many parts of the country, roads are crisscrossed by power lines which are VERY hard to see from the air. The poles are evident, but the direction of the wires can be deceiving. Add automobile traffic to the picture, especially oncoming traffic, and the approach is suddenly very complicated indeed!

Even if you negotiate a successful touchdown free of auto traffic, there are often roadside signs to contend with and other roadside hazards. Depending on the width of the road and the aircraft's wingspan, a wing strike could cause considerable damage and a loss of directional control. One more pitfall is that many roads have drainage ditches on either side which makes loss of directional control potentially very serious including the possibility of a noseover. Many aircraft have executed successful emergency landings on roads from rural dirt roads to highway interstates – it can be done. This discussion is simply meant to raise awareness of the potential hazards.



Generally speaking, power lines tend to parallel the road, but pay close attention. Notice how the poles cross to the other side on this stretch of I-95 in Northern Nevada (left). Rural roads (right) are similar.

As for fields – they present their own hazards, mostly due to the softness or unevenness of the terrain but also due to other difficult-to-spot perils. A field can be clear, wide open, and free of vegetation from high up and yet contain ditches, potholes, plowed areas, or very soft ground all leading to damage or a potential noseover. Furthermore, there may be sparse livestock out there which can be hard to spot and potentially harmful in the case of a large animal. Finally, fences, especially barbed wire can be perilous and very hard to see until it's too late. In this situation I would advise aiming for a post to take down the fence – do NOT aim for the barbed wire.

As you can see, there is no perfect solution or universal answer. Keep the hazards in mind and pick the most wide open option while executing a low energy, tail low touchdown whether it's a field or a road. Roads and fields generally offer the best options for a safe off airport landing with minimal damage to the aircraft. The mindset of this discussion so far has centered on a successful off airport landing meaning no injuries and minimal (if any) damage to the aircraft or property. Moving forward, we will look at a few other options that are less than ideal (for example, forested areas, water, mountains). But first, I'd like to digress into a discussion of crash survivability.

Crash Survivability – the Human Body

Moving forward, we will assume that we are now faced with a situation where damage to the aircraft is reasonably assured and our mindset is now minimizing casualties to the pilot and passengers. The biggest pitfall is a reluctance to accept the situation. Accept it – and act! The second pitfall is a desire to save the aircraft. Hey, the insurance company just bought the aircraft, so let's not jeopardize lives in an attempt to save the insurance company's new airplane! The final pitfall is fear of injury – worry about that after the airplane stops. Before touchdown, open a door so that it doesn't jam during the crash and have something on board that can break the windows. Most important is to maintain airspeed and control all the way down and to find a way to sacrifice the airplane's non-cabin areas (wings, gear) to dissipate the crash energy as smoothly as possible. Do not relinquish or lose control! As the late airshow pilot Bob Hoover used to say: "Fly the thing as far into the crash as you can!"

Let's begin by discussing a simple measure by which we can judge the "severity" of an accident in terms of potential human casualties. Consider the following data, for example. Examine the loading



On the other hand, here's a section of I-80 west of Salt Lake City with unlimited potential: no crossings, no power lines, and great fields in the event traffic doesn't work out.



Another "good road" example: I-80 in eastern Nevada: it's the only landable terrain.

$$F\Delta t$$

$$\text{Impulse} = \text{Force} \times \text{time}$$

A large force applied for a short time and a small force applied for a longer time can yield IDENTICAL physical impulses

charts at the bottom of the article [“Determining Aircraft Crashworthiness” published on DVI Aviation’s’ website](#) illustrating human tolerances for G loadings in the vertical and horizontal directions. If we look at the data for horizontal G tolerance (the first chart) we can see that the body can withstand over a 40G deceleration for up to 0.1 seconds. Exposure to this G loading for longer than this amount of time puts us in the “moderate” and “severe” injury zones depending on the length of time. Lower G loadings permit longer “exposure” times – according to the data we can sustain a 10G deceleration for nearly two seconds. The data in the vertical direction obeys the same trend, so what is really going on here?

Bigger impulses lead to bigger injuries. So, the broad question becomes: how do we minimize the impulse?

In physics, the “Impulse” applied to an object represents the total change in momentum of that object. Impulse is equal to the product of force x time, so a large force applied for a short time and a small force applied for a longer time can yield IDENTICAL physical impulses. Therefore, what the data above is telling us is that the threshold for moderate and severe injuries is a function of the total impulse delivered in the crash whether it is a large force delivered for a very short time or a smaller force delivered over a longer period of time. Bigger impulses lead to bigger injuries. So, the broad question becomes: how do we minimize the impulse?

The short answer is: we really can’t. Let’s make note that assuming an aircraft approaches and touches down at the appropriate speed its momentum at touchdown will be the same each time (neglecting the effects of density altitude, of course). So the impulse required to stop it will be the same each time. The thing we can try to control is the size of the force and the time over which it is applied. As we said at the beginning of this section: “dissipate the crash energy as smoothly as possible.”

As a final thought, let’s examine how much stopping distance is required if we are willing to sacrifice the airplane. Let’s begin by considering a touchdown speed of 50MPH and a 9G deceleration. To be honest, this would be a pretty uncomfortable deceleration, but we will see that the data shows it to be quite survivable: the calculated stopping time under these conditions is only 0.254 seconds. According to the data presented earlier, a 9G deceleration for 0.254 seconds is not near the threshold of even moderate injuries and should be survivable if not highly uncomfortable. Here’s the really surprising part: the calculated stopping distance under these conditions is only 9.34 feet! It’s hard to believe, but if you

dissipate the energy properly it doesn't take much room! If we can manage a 4G deceleration at this speed the numbers are 0.572 seconds and 21.0 feet, quite surprising indeed.

If we double the speed to 100MPH, the impulse doubles and the kinetic energy quadruples, so a 9G deceleration takes 0.509 seconds and 37.34 feet, while a 4G deceleration takes 1.15 seconds and 84.02 feet, less than a third of a football field! Bear in mind, we have only considered deceleration energy as a source of injury. If people aren't properly seatbelted, or there are projectiles flying around the cabin, or if the cabin is compromised or destroyed then all bets are off. Having noted that, let's finish by thinking about how to apply this.

Poor Options and Best Advice

Let's begin examining some increasingly bad situations: we'll begin with a field, but one with crops or obstructions. In this case, there will be damage to the aircraft, but if we can avoid the pitfall of worrying excessively about the damage, these situations are very survivable. Rows of corn or other crops will decelerate the aircraft rapidly but smoothly, exactly what we want. Even sparse trees can be used to damage the wings and decelerate the aircraft in a survivable way. "Non-perfect" fields may damage the aircraft, but we can manage the deceleration, so don't throw away a perfectly survivable situation in search of the "perfect" landing field. Just don't allow the cabin to stop suddenly.

Increasing the degree of difficulty is a forest or tree landing. Heavily wooded areas present an obvious challenge in that the airplane is almost certainly not going to contact the ground first. Fortunately, these types of "landings" are very often survivable! The suggested technique is to use a normal approach configuration with full flaps into the wind to minimize ground speed. At contact with the trees, we want the aircraft as slow as possible with the nose high. Staying above stall and not letting the nose drop is important in using the underside of the aircraft as a shield. Given a choice, dense low forestation is preferable to taller sparse trees. As tempting as the sparse stuff looks, it's like landing among a field of telephone poles. Done properly, the dense forest is actually a better cushion. A final note: many forests have relatively small clear cut areas scattered throughout them and these can be looked at as "non-perfect" fields and could present an alternative to a tree landing. Whether the aircraft would suffer less damage would depend completely on the specific circumstances.



Here is an example of a "less desirable" field in the Sierra Nevada mountains north of Reno, NV. Notice that it is flat enough to put down a GA airplane. You're very likely to substantially damage the airplane, but it should be survivable if you touch down with minimal energy.



Similarly here: uneven and lots of vegetation with an upslope to decelerate the airplane. Pay attention for fencing and aim for a post.



Dry lake beds make great “fields” – as long as they are dry. This is ground level in the great Salt Lake desert.

Water presents a still more challenging set of circumstances. If we are flying a fixed gear aircraft, there is a strong likelihood that the aircraft will flip over presenting an immediate post crash survival situation. If you have several passengers, this could be a very chaotic and dangerous situation. Water is not always a bad choice, especially in a retractable gear airplane. However, it presents you with a (potentially very) challenging post crash environment. Moreover, if your technique is poor, hitting the water can be like hitting concrete resulting in a very sudden stop and our discussion of accident survivability told us this is exactly what not to do. Consider water landings in your aircraft very carefully.

Mountains are a big challenge for the light GA pilot. There are, in some areas, precious few places to go if you lose the engine, so mountain flight should be carefully considered with respect to off airport landings. Attempting to land on a steep ridge is not an option, so the mountain environment is a place where off airport landing safety begins with the planning of the route. Staying near roads and population centers maximizes your chances of having a good option (or at least a chance) if the engine goes. Dry lake beds are also common out west. These are often GREAT emergency landing sites – the major pitfall is that it can be very much like a glassy water landing where it becomes difficult to judge your height above the ground. Another option in the mountains would be a stream or a river. The water is shallow and we are only looking to find a situation that gives us a survivable deceleration. Beware: it only takes six inches of water to drown.

For more information on off airport landing scenarios, visit the [AOPA website](#).



About the Author

Colin Aro holds a B.A. in Applied Mathematics from U.C. Berkeley and a Ph.D. in Engineering - Applied Science from U.C. Davis. He is a commercial pilot and flight instructor rated for single engine airplanes, multi engine airplanes, and gliders. He is a FAASTeam representative working out of the Reno FSDO specializing in mountain flying safety. He currently serves as the operations officer for the High Sierra Squadron of the Commemorative Air Force, overseeing the operations of the squadron's N3N-3 and L-19 aircraft. He flies and performs with the Northern California Beech Boys formation demonstration team. Colin lives in Reno, Nevada with his wife and son.

The Technology of Last Resort

How will rescuers find you if needed?

As pilots, we are trained to overcome adversity in the cockpit. From weather issues to electrical, mechanical, and even total engine failures, we are taught to never stop flying the aircraft. However, for an unfortunate few pilots each year, their best efforts in the cockpit result in an off field landing over remote or inhospitable terrain. Once on the ground, the most pressing issue becomes a swift rescue.

Emergency Locator Transmitter

Since the FAA mandate in 1973, the defacto standard for aircraft rescue has been the Emergency Locator Transmitter (ELT). The original ELTs transmitted on 121.5 MHz (guard frequency) and the position of the downed aircraft had to be triangulated using directional receivers employed by rescue agencies such as the Civil Air Patrol. More recently, modern ELTs using 406 MHz are capable of transmitting the aircraft's precise GPS position, but only if this option is configured during installation. Unfortunately, ELTs have never been a reliable method of finding an aircraft following a crash. Aside from an overwhelming number of false alerts, the units themselves have a questionable track record in real-world accidents.

A 2017 NASA study showed a less than 30% success rate for ELTs when they were needed most



Photo provided by Jeff Simon

Legacy 121.5 MHz ELTs are being replaced by new 406 ELTs, such as this ARTEX 345 unit that include lithium batteries that can last up to five years.



Photo provided by Jeff Simon

The latest radios, such as this Icom IC-A25N include radio and GPS navigation features that increase their usefulness both in the air and on the ground.

A 2017 NASA study of ELT effectiveness found that out of 86 “Injurious or Fatal Accidents” over a five-year period from 2009-2014, the ELT failed to operate in 61 of them. That represents a less than 30% success rate for ELTs when they were needed most. The reasons were varied, but included antennas or cables failing, as well as testing that showed that the antennas would remain capable of transmitting a signal less than one minute if exposed to fire. Although ELTs remain a legal requirement, the facts seem to indicate that they are not your best bet as a lifeline to get help.

VHF radio

The next historic “go-to” for rescue is the portable VHF radio. The advent of low-cost, handheld aviation radios has made them a mainstay for nearly every pilot’s flight bag. Their “triple-duty” role as a backup for in-flight communications, emergency rescue communications and airport/airshow entertainment receiver makes them an easy sell. However, in reality, they aren’t an ideal tool to reach out for rescue. VHF radios require line-of-sight to communicate and there is the additional requirement that both transmitter (you) and receiver (your rescuer) be using the same frequency. You could certainly use 121.5 to call for help, but not every aircraft likely to fly overhead may be listening on the frequency. A better approach might be to set the radio to scan mode and wait to hear an aircraft transmitting nearby on a different frequency...then call for help on that. It’s better than relying on your ELT, but the odds aren’t in your favor. Oh, and don’t forget to keep that radio charged. The last time I pulled my radio out of my flight bag it was dead...so, lesson learned: “Charge Before Flight”.

Personal Locator Beacons (PLBs) & GPS trackers

Jumping WAY up on the technology ladder, we come to Personal Locator Beacons (PLBs) and GPS trackers. These small, portable units utilize GPS satellite technology coming down from the heavens to track your position and then reach back up again to communications satellites to send your position out to whomever you setup to track you. PLBs such as the SPOT Satellite Personal Tracker and Garmin inReach Satellite Communicator are constantly tracking your GPS position, but only report it out when activated (unless put into a tracking mode). GPS trackers such as Spidertracks default to sending your location at regular intervals so that friends or family can watch your progress on a flight or hike through the wilderness. The challenge with both systems is that they don’t directly indicate that you need rescue until you activate



SPOT – Satellite Personal Tracker

them in an SOS mode. This means you need to be conscious and able to reach/activate the units to call for help. That is unless you link your GPS tracker to your flight plan with Flight Service. Leidos' Flight Service website (1800wxbrief.com) allows you to register and link GPS trackers such as Spidertracks and InReach with every flight plan that you file. Their system automatically monitors the tracking reports along with your flight and alerts Flight Service if you appear to stop moving during your flight. It's an excellent way to have someone watching your back, even when you are outside of radar coverage.

A note about subscriptions: In general, PLBs do not require any subscriptions as they are intended for emergency use only and send out a signal on government-run satellite systems for the sole purpose of rescue operations. Messenger devices (GPS trackers) or enhanced PLBs with messenger/tracking services are generally run by private companies and require subscription services. For example, at the time of this writing SPOT charges a \$19.95 activation fee for their devices and subscription fees range from \$9.95/month to \$29.95/mo. The Garmin In-Reach monthly fees vary from \$11.95/mo. to \$64.95/mo. and Spidertracks plans range from \$29/mo. to \$79/mo. The premium you pay for these tracking services is representative of their use for much more than search and rescue. They are a means for you to stay in touch with loved ones, allow them to track your progress and remain connected when you're out of traditional cell coverage.



Spidertracks, Spider S6 Portable Global Tracking Solution



Garmin inReach Explorer

Nearly all aircraft have been equipped with ADS-B, sending out a constant stream of GPS-based position reports that can be used by rescuers

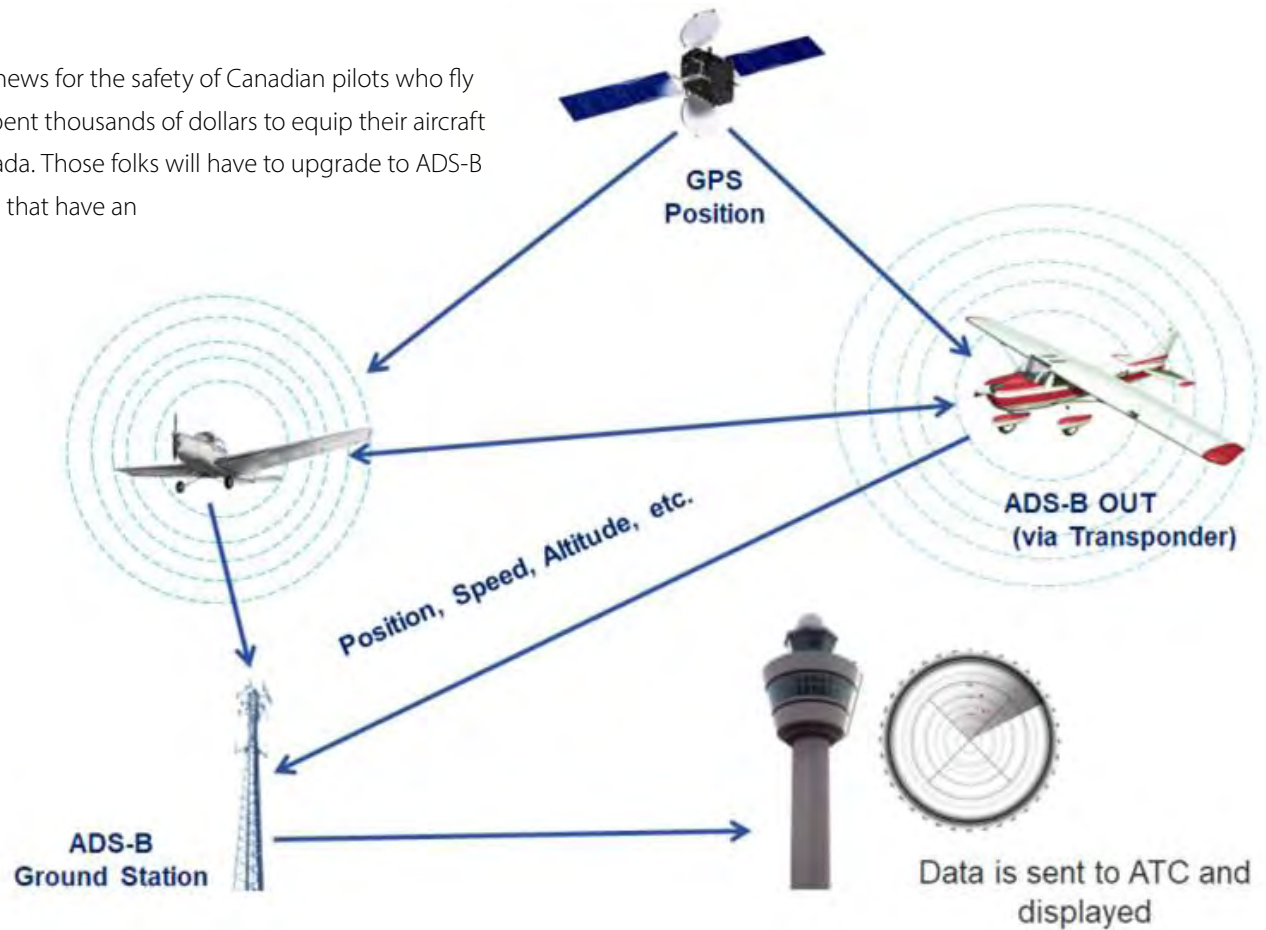
If there was one good thing that the dawn of 2020 brought to aviation, it was the passing of the ADS-B mandate deadline. We now live in a world where nearly all aircraft have been equipped with ADS-B, sending out a constant stream of GPS-based position reports that can be used by rescuers to track the progress of a flight up to the point that contact was lost.

As a ground-based system (in the U.S.), ADS-B has coverage limitations based on altitude, terrain, and ground-station coverage. Therefore, it can still be a dead-end if an aircraft is lost in remote terrain. However, it's far more accurate and has better coverage than traditional transponder & radar tracking ever had. It should be noted that Canada is implementing a satellite-based ADS-B system that will allow

complete coverage, regardless of the terrain. That's good news for the safety of Canadian pilots who fly in remote areas, bad news for non-Canadian pilots who spent thousands of dollars to equip their aircraft with ground-based ADS-B systems and want to fly in Canada. Those folks will have to upgrade to ADS-B systems with "Diversity", which is a fancy word for systems that have an antenna on both the top and bottom of the aircraft.

Smartphones

The last and arguably highest technology option is one we all have handy: your cell phone. The reality is that most modern day search and rescue operations begin and end with cell phone tracking. Most rescue agencies have emergency access to your phone's location as reported to the cell phone network. Even while flying, if your phone is turned on, you are bouncing in an out of different networks and towers. In addition, while within range of data networks such as 3G or LTE, chances are that your exact GPS location is also being reported out in a way that rescuers can track. Of course, cell phone tracking can only do so much if you're flying across vast regions without coverage. But, your flight path and speed can still be extrapolated from the last reported location to help rescuers locate you even if your travels take you out of coverage.

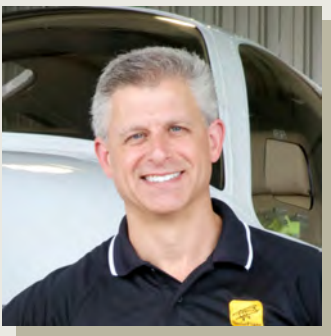


"The reality is that most modern day search and rescue operations begin and end with cell phone tracking."

The bottom line is that the technology options that are right for you depend on the type of flying you do. Pilots flying in the sparsely populated backcountry have a greater need of independent solutions than

those flying between major cities in crowded regions. For those pilots, installing a 406 ELT in conjunction with GPS position reporting is essential. In addition, PLBs add an extra level of security that's critical in the backcountry. For pilots who rarely leave populated areas, leaving your cell phone on may be good enough. However, no piece of equipment is as important as having someone know where you are and where you are going at all times. This includes putting ATC at the top of the list. Their job is literally to watch your back. Use flight following anytime that you're within radar coverage, even if you're just out maneuvering. There's nothing wrong with telling ATC that you'll be "maneuvering at XXX location" while you're out shaking off the rust and just having fun. They'll be able to vector traffic around you and keep an eye on you as well in case you drop off the scope without warning.

For those pilots who routinely fly out of radar coverage, file a flight plan and fly the plan. And, choose the technology solution that's right for you so that you can call for help if needed. In the event of an off-airport landing, early rescue is critical to the survival of both you and your passengers. There are many options available for a surprisingly low cost, and the peace of mind is priceless.



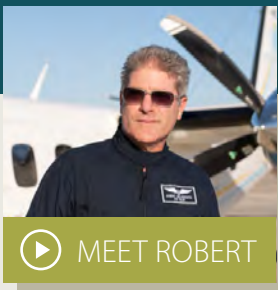
About the Author

Jeff Simon is an A&P mechanic, IA, pilot, and aircraft owner. Jeff is also the creator of SocialFlight, the free mobile app and website that maps over 20,000 aviation events, \$100 hamburgers and educational aviation videos. Free apps available for iPhone, iPad, and Android, and on the web at www.SocialFlight.com

Hear from the experts

How to prepare for survival

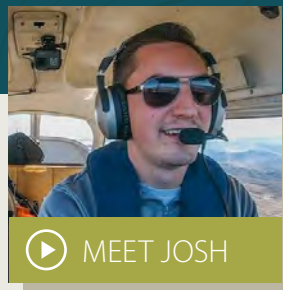
In the late Winter of 2021, Lightspeed Aviation held a competition to promote awareness around creating the right survival gear kit for pilots. Lightspeed recruited four celebrity judges who are experts in the field of aviation and particularly survival preparedness. Each of these judges have their own fields of study and training to position them as knowledgeable subject matter experts. In this chapter, you can meet the judges, and gain some key takeaways of survival knowledge based on their impressive experience.



Robert DeLaurentis

Circumnavigation and preparedness

Known as the Peace Pilot, this aviation circumnavigator, author, speaker, and naval Gulf War veteran tells us how to prepare for survival in extreme conditions. During the preparation for his 2020 Pole to Pole flight, he learned there is not a lot of room for errors. DeLaurentis continually uncovered risks over 3 years of preparation that need to be mitigated, and he learned “(he) was the most likely part of that mission to fail”. Ask yourself, “What’s your survival worth to you?”



Josh Flowers

Teaching survival through What Ifs

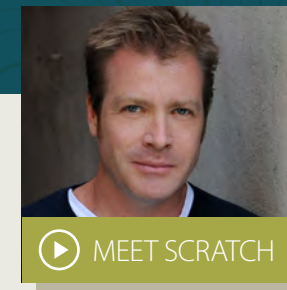
As a YouTube influencer and educator Flowers uses his CFI role to train General Aviation pilots in survival. He asks his students when preparing for an off airport landing, “you got it on the ground...now what?” And watches as each of the students’ light flicker. He tackles his training in two ways: handling the situation after the crash, and after it’s handled how do you get found or get to help. Also hear how he executed a 180 back to the airport “the impossible turn” right after takeoff at night. “It’s always a learning experience.”



C.W. Lemoine

Military survival training applied to GA

You may know Lemoine as the author of the military espionage Spectre series. He is also an F-16 pilot with a combat tour in Iraq under his belt. His Air Force training in survival taught him the skills needed if he were ejected from his plane – how to live off the land, create shelter, find food, and most importantly, get rescued. His advice to GA pilots: “Know your equipment and your self-limitations.”



Robert “Scratch” Mitchell

Psychology of being immersed in the wilderness

A producer, director, and actor developing a film about the true story of a bush pilot who survived for 2 months in the Arctic — and a 3rd generation military pilot and fighter pilot. He trained himself in being under duress in the wilderness, surviving alone for 2 nights in the Canadian wilderness. Finding out “you’re no longer the top of the food chain, but you’re part of the food chain” keyed in that psychological preparedness was the key to survival rather than physiological efforts

Survival Gear Contest 3rd Place Winner

Noah Alexander

Please join us in congratulating the Third Place Winner of our recent Survival Gear Contest: Noah Alexander. A panel of Celebrity Judges gave Noah's entry high praise for his personal floatation device vest and speaking towards the topic of training. Judges remarked, "A well-considered approach!" and "A top contender!" Enjoy Noah's submission below.

On-Body Equipment

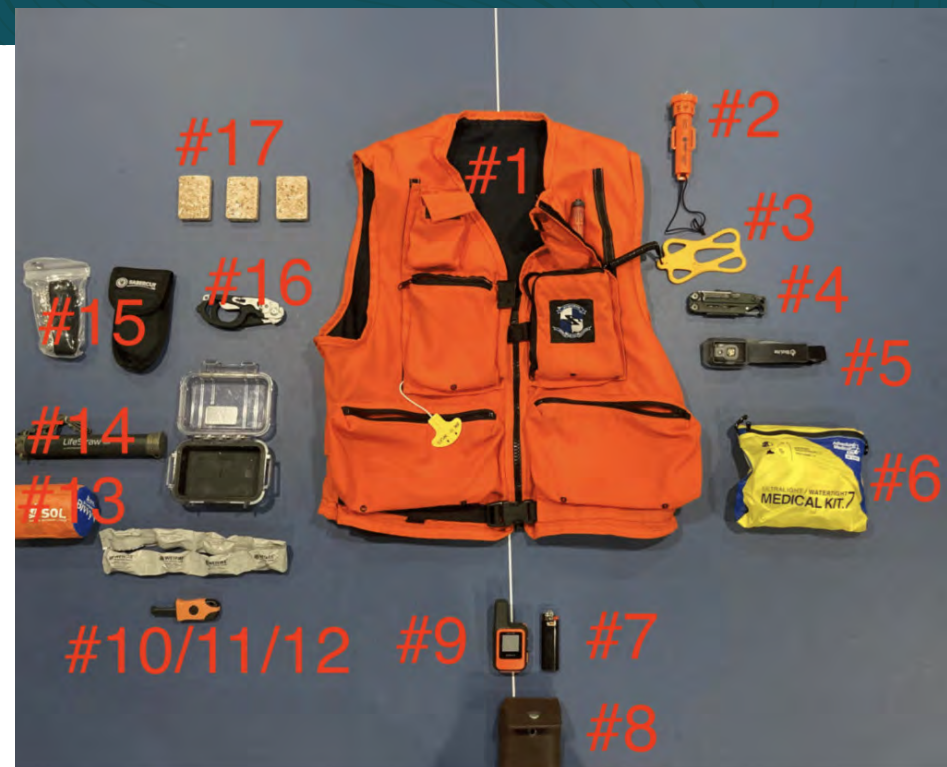
Location: This equipment is all kept either in the Stearns float coat (item #1) or in the leather belt pouch (item #8). All of this equipment is worn on the body and is therefore accessible at all times, which is especially useful in a ditching situation.

#1 Stearns float coat - an effective PFD after ditching the aircraft for a swimmer that is conscious while also providing ample storage solutions for survival equipment. It allows for automatic inflation via a CO2 cartridge as well as oral inflation through the red tube on the left side (pictured).

#2 See-Me strobe light - waterproof 45 lumen strobe light that can be seen by rescuers searching for occupants of a crashed aircraft for up to three miles during nighttime. The light can be manually activated by the user or is automatically activated in water.

#3 Phone holder with a lanyard attachment - attaches a cell phone to the vest to reduce the risk of loss during a crash so that the phone can be used to contact rescuers.

#4 Leather man Signal - multitool with increased emphasis on tools that would aid in building a fire and shelter, or in signaling rescuers in a post-crash situation.



#5 USB Rechargeable Headlamp - primary light source to aide in conducting post-crash activities such as evaluating the health of passengers or building a fire/shelter.

#6 2-Person First Aid Kit - includes all standard items found in a first aid kit needed to treat basic first aid problems that could be created during a crash. It is also waterproof.

#7 Bic Lighter - standard lighter that acts as an easy fire starter in a survival situation.

#8 Leather Belt Pouch - holds: a Garmin inReach Mini, a Bic lighter, and a preflight flashlight (not pictured) to serve as a more secure place to keep essential items that would be needed after a crash.

#9 Garmin inReach Mini - personal GPS location device for contacting rescuers in the event of a crash. It is also water submersible and shock resistant.

#10/11/12 UST Sparkie fire starter and Wetfire tinder - combined in a waterproof Pelican case to serve as a secondary method for starting a fire in a survival situation.

#13 SOL Bivy Sack - a highly compressible shelter that can be set up quickly or supplement a more refined emergency shelter to protect aircraft occupants from the elements after a crash.

#14 LifeStraw - a portable water purifying filter that eliminates the need to build a fire for safe water consumption.

#15 Sabercut - a portable chainsaw that can be used for gathering large branches for building an emergency fire or shelter.

#16 Leatherman Raptor - high-strength shears that can be used for: removing clothing quickly to administer medical treatment, salvaging robust material from the crashed aircraft, or breaking glass with the glass-breaking bit.

#17 Datrex Ration Bars - emergency food source for post-crash consumption that has a shelf life of five years.

Flight Bag Equipment

Location: This equipment is kept in a flight bag that always located on a passenger seat within reach of the pilot.

#1 PJ2 COM Radio - Battery or USB powered handheld radio that supports conventional operation as well as operation with an aviation headset through dual GA plugs. Despite the limited range of this device, it could be an invaluable resource in the event of a crash should the pilot be able to establish communications on an area frequency with rescuers.

#2 Portable Battery - portable charging device that could provide power to a multitude of devices in a survival situation such as a phone, a light, or a handheld radio.



#3 Tissues - Auxiliary clotting device for administering medical treatment alongside first aid kits or a tinder device for starting a fire.

#4 Flint and Steel Kit - small bag containing a flint and steel to provide another fire-starting tool in the event of a crash where other fire-starting equipment could not be recovered. It is used instead of a second lighter to eliminate the presence of combustible fuel within the flight bag.

#5 Compressible Water Flask - provides a way to transport water for consumption in a post-crash situation in the event that another container could not be recovered from the aircraft.

#6 Knife Sharpener - primarily carried in conjunction with the required equipment kit discussed below as it can aid in the use of the other survival tools such as a hatchet, or fishing equipment.

#7 Single-Wall Stainless Steel Bottle - in a post-crash situation, it would primarily be used for the purification of water by placing it in a campfire to boil the water.

#8 USB Rechargeable Flashlight - an additional light source that can be used in a variety

of ways in a survival situation such as signaling or completing tasks in the dark.

#9 Battery Powered Headlamp - provides redundancy for the USB rechargeable headlamp and accomplishes survival uses of a light source.

#10 Battery Powered Flashlights - provides a light source for occupants that may not have carried one on the flight and provides redundancy for the USB rechargeable flashlight and accomplishes survival uses of a light source.

#1 Snow Shoes - used to more efficiently traverse a snow-covered environment post-crash.

#2 Sleeping Bag - used as an emergency source of shelter in a freezing environment to increase chances of survival.

#3 Mosquito Head Nets - used to prevent occupants of the aircraft from being afflicted with copious amounts of mosquito bites in a post-crash situation.

#4 Signaling Flares - provides a means of signaling rescuers in a post-crash situation.

#5 Emergency Survival Blanket - similar to the Bivy Sack shown above, it provides a source of shelter for aircraft occupants in a post-crash situation.

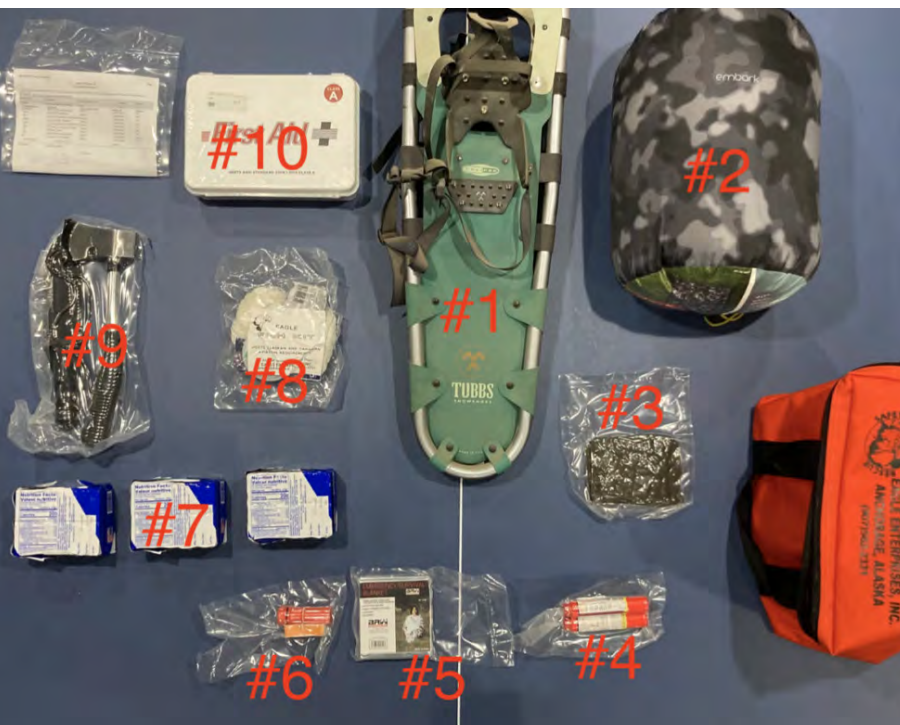
#6 Waterproof Matches - provides an additional tool for making a fire in a survival situation.

#7 Datrex Ration Bars - emergency food source with a shelf life of five years.

#8 Fishing Kit - supplies of line and hooks to aid in obtaining food in a survival situation.

#9 Hatchet and Fixed Blade Knife - tools to help complete the numerous tasks required to survive in a post-crash situation such as making a fire or shelter.

#10 Class A First Aid Kit - contains more resources for treating medical emergencies that are created by a post-crash situation than the first aid kit carried on-body.



Required Equipment

Location: This equipment is kept in the baggage compartment of the aircraft and likely out of reach of the pilot. Depending on the nature of the crash, this equipment would be the first to be left in the aircraft, if necessary, to prioritize the safety of the occupants.

I think the single most important post-crash tool that every pilot should be carrying is a waterproof tool for starting a fire. It could be matches, a ferro-cerium rod, or a lighter, but it should be something that the pilot is competent in operating. I feel this is the most important thing for a pilot to carry because it is unlikely that drinking tainted water will cause a person significant harm before rescuers can recover them, and because it is likely that the crashed aircraft will have a functional ELT.

Aside from carrying equipment, additional preparedness steps to take that could increase the chances of surviving a crash include: filing a flight plan for every flight, completing refresher training with a CFI that includes simulation of different crash scenarios, and undertaking other types of training that could aide in post-crash situations such as EMT or wilderness survival training.



Survival Gear Contest 2nd Place Winner

Pedro Fonseca

Please join us in congratulating the Second Place Winner of our recent Survival Gear Contest: Pedro Fonseca. A panel of Celebrity Judges gave Pedro high praise for his presentation. One judge commented, "The wet wipes are a good addition! I haven't thought of that." Enjoy Pedro's video submission [on the Lightspeed Aviation blog](#).



Not online? Scan this code with your phone's camera to watch Pedro's video

Survival Gear Contest Grand Prize Winner

Jason Moody

Please join us in congratulating the Grand Prize Winner of our recent Survival Gear Contest: Jason Moody. A panel of Celebrity Judges gave Jason high marks for accessibility, water purification, and his selection of vest. One judge commented, "Amazing survival preparedness!" Enjoy Jason's submission below.

My personal survival kit is fitted into a FlyKandy pilots jacket. Originally designed for paramotor flyers, it is perfect for general aviation use with a total of 10 large pockets. This enables a survival kit to be with me at all times when needing to exit the aircraft in a hurry.

My Lightspeed DeLaurentis flight bag carries additional back up supplies, and some equipment that would be nice to have, but not essential.

The UK isn't blessed with the millions of square miles of wilderness that some other countries enjoy. So realistically, even with poor weather, I would expect to receive help within a 48 hour timeframe. To this end the kit is designed primarily to equip me with emergency medical supplies, and the ability to provide shelter and warmth.

Items such as emergency fishing kits haven't been catered for as in the time frame I plan for, food won't be a major issue.

Medical Module

The medical module contains both traumatic injury treatments, and kit to treat non life threatening scrapes and cuts. Pain relief, antihistamine and diarrhea tablets complete the first aid kit.



Vacuum packed to protect the contents from moisture the first aid kit is located primarily in the two large chest pockets, along with additional kit in the flight bag.

Contents Trauma

- Israeli Pressure Bandages X2
- Celox Rapid hemostatic gauze and granules
- Ratcheting Medical Tourniquet

Contents First Aid

- Suture Strips
- Selection Of Gauze
- Selection Of Bandages
- Adhesive Bandage Wrap
- Sterile Plasters
- Insect Bite Patches
- Small Scalpel
- Antiseptic Wipes
- Nitrile Gloves
- Burn Gel Packs
- Vetbond Tissue Glue

Fire Module

In line with common recommendations the fire module contains a number of different methods of starting fires without having to rely on something like a string bow, which I feel would be time wasting if fire is urgently required.

The fire module is in the right hand internal chest pocket with additional kit in the flight bag.

Contents Flight Jacket

- Matchcap XL Match Safe. With stormproof matches and tinder strips
- Happy Swede Magnesium block with ferrocium rod and striker
- Ultra Fine Wire Wool Tinder

Contents Flight Bag

- Vacuum Packed Stormproof Matches and Tinder Strips
- Ultra Fine Wire Wool And 9v Battery
- Vials Of Potassium Permanganate And Glycerin (exothermic chemical reaction creates a rapid fire)

Water Module

Although in the time frame I expect rescuing in, food isn't regarded as a major problem. Water could be. Dehydration can set in relatively quickly so I have a number of purification options, ranging from chemical to filtration.

The water module is in the left hand internal chest pocket with additional kit in the flight bag.

Contents Flight Jacket

- Sawyer Squeeze Micro Water Filter And Straw
- Collapsible 1litre water pouch
- Chlorine Dioxide Tablets
- Contents Flight Bag;
- Chlorine Dioxide Tablets
- Collapsible 1litre water pouch
- Vial Of Potassium Permanganate (small quantity acts as a water sterilising agent)



Communications Module

Current research shows that the ELT devices in aircraft are not the most reliable of devices. Arranging prompt rescue could be a life saving measure.

Devices to alert search and rescue, and to also provide signaling to rescuers is distributed between the flight jacket and bag.

In the jacket these are located in the top left sleeve pocket.

Contents Flight Jacket

- Garmin In Reach Satellite Terminal
- Greatland Laser Flare
- Small Signalling Mirror
- Rescue Whistle
- Bright Orange Bandana
- Led Lenser Flashlight
- Micro LED flashlight and strobe

Contents Flight Bag

- Rescue Whistle
- Smith And Wesson Flashlight
- Yeusa Hand Held Transceiver
- Shelter And Tools Module

Shelter Module

My final module contains emergency shelter and warmth, along with tools for shelter building. The emergency candles can also be used with the ponchos to create a Palmer Furnace.

The 2 front bottom pockets contain the bulk of these, with some additional items in the flight bag and lower sleeve pockets.

Contents Flight Jacket

- Bothy Bag 2 Man Emergency Shelter
- 2 Emergency Mylar Ponchos
- 2 Emergency Mylar Beanie Hats
- 6 Chemical Hand Warmers
- 3 Emergency Candles 5 hours each.

- Fellkniven F1 Knife
- Leatherman Wave
- 50 Metres Of 550 Paracord
- 10 Metres Gorilla Tape
- Spare Flashlight Batteries
- 5 Metres Stainless Wire
- Mechanix Gloves

Contents Flight Bag

- 3 Emergency Candles 7 hours each
- Orange Bandana
- Mini Solid Fuel Stove
- Smith And Wesson Flashlight
- Yeusa Hand Held Transceiver

Additional Kit

There are also some high energy food bars, powdered coffee rations and honey energy drinks contained in various additional pockets.

A final item is a vacuum sealed copy of the FAA survival guide.

What Wouldn't I do Without

I feel the single most important item in the kit, is my Fellkniven F1 Swedish survival knife. It can be used for extracting myself or passengers from a damaged aircraft. Building a shelter, building a fire. All essential activities that would be far more difficult without it.

Additional Preparation

I feel the best additional preparation that is possible, is education. We spend a large amount of time training for engine failures, EFATO, etc. But few people take the time to learn what to do in the event of an off airport landing. I suppose it is the 'can't happen to me' mindset.

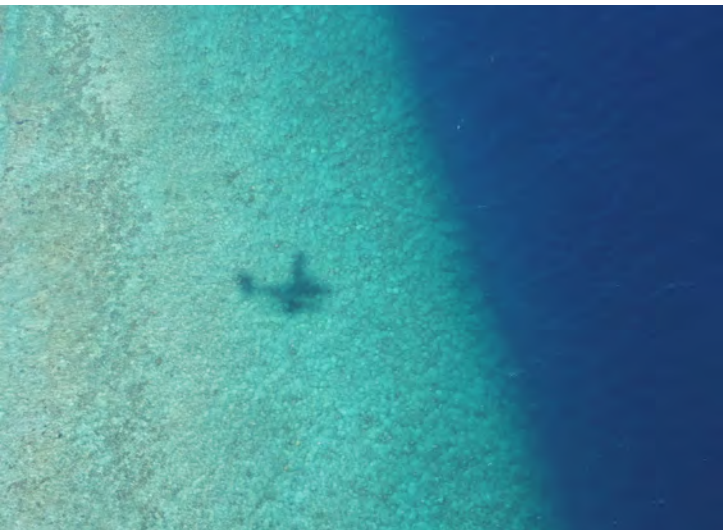
I have it on my list once the covid restrictions are lifted, to take both a wilderness medical course and an outdoor survival training course.



Environment Determines the Kit

Every survival kit has to provide the basics: first aid, locator beacon and signaling equipment, food and water — plus multi-purpose essentials such as a survival knife and mylar (space) blankets for warmth, sun and moisture barrier, and signaling. These items should be carried on your body, so they'll exit the aircraft with you, no matter what, and you should always dress to survive conditions on the ground. ("Dress to egress.") But, beyond the basics, every pilot needs to decide what survival gear is important enough to merit space in their flight bag or cargo hold. Those decisions should be determined by the environment you have to survive in.

Here are some recommendations based on various environments and conditions from the many pilots who answered our question, "what's in your survival kit?".



Fresh- or Salt-Water Environments

If you have to make a forced landing in a marine environment, first make sure you meet all the requirements spelled out in the FAA Federal Aviation Regulations (FARs). You can find the rules for overwater operations here. *(Our pilots also pointed out that you want flotation devices that won't auto-inflate, potentially trapping you or passengers in a ditched aircraft with rising water.)*

Other good kit items include:

- A marine radio for contacting the Coast Guard or other vessels in the area
- Signal dye marker powder to make your location visible on water, land, or snow
- Survival clothing that's warm, even when wet
- Insect repellent
- A fishing spool with hooks and lures stowed in the handle

Cold Latitudes and Altitudes

In a frigid environment, clothing, shelter, and fuel will help keep you warm and alive until SAR can reach you.

Alaska statute 02.35.110i also requires snow shoes in the equipment loadout. Your choice, but Alaskans should know! (You can find the statute with [specific requirements for flying in Alaska here.](#))

You should have:

- Layers of clothing: Goretex jacket, thermal underwear, gloves, hat, neck gaiter, microfiber or Smartwool socks, snow boots, and rain gear
- Hand-warmer packs
- Tarps and nylon cord for shelter
- Fire-starting supplies, a knife or hatchet, and a pot or metal water bottle for boiling water
- High-energy food
- Bivvy sack(s) or synthetic sleeping back large enough to be shared



Mountain Terrain

In back country and mountainous terrain, weather conditions can change quickly, and even in good conditions, a downed aircraft can be hard to spot. You may be on your own for some time waiting for rescuers to locate you.

If you have room in your craft, a self-inflating air mattress can insulate you from snow or the cold or wet ground.

Your kit should contain all the items listed for Cold latitudes and Altitudes, plus:

- Flare gun with day and night signal flares
- Folding snow shovel
- Portable GPS
- Area maps or charts
- Climbing sunglasses or snow goggles



Desert Environments

In the desert, water and sun protection are critical.

Your kit should include:

- Lots of water plus electrolyte tablets or powder
- Sunglasses, hat, and light sun-proof shirt or jacket
- Sunscreen and UPF lip balm
- Light warm clothing (because desert nights can be cold)

Prepare for Injuries

A well-stocked medical kit is survival item #1, regardless of where you land.

Here are some recommendations from the Mayo Clinic for a basic first aid kit:

- Duct tape
- Blood clotting kit
- Rubber tourniquet. (A number of pilots recommend carrying Israeli emergency bandages for staunching wounds or

- immobilizing a broken limb.)
- Nonstick sterile bandages and roller gauze in assorted sizes
- Instant cold packs
- Antiseptic solution and towelettes
- Eyewash solution
- Turkey baster or other bulb suction device for flushing wounds
- Sterile saline for irrigation, flushing
- Breathing barrier (surgical mask)
- Hydrogen peroxide to disinfect

A Few More Thoughts

Some other good items appear in many pilots' survival lists, regardless of terrain:

- Anywhere predators are a real threat, have defense—pepper spray, bear spray, and/or a compact firearm and ammunition, depending on the kinds of predators you may face.
- Every pilot seems to have a favorite survival manual. Pack yours!
- Garbage bags, sheets of aluminum foil, and duct tape take up almost no space and can be MacGyvered to meet many survival needs.
- Bring charged (ideally, solar rechargeable) backup batteries for charging cell phones and other devices.

We hope these lists are useful, but the best person to anticipate your needs is you. If your flight plans include areas with unusual conditions, try to anticipate what you might need. If you or a passenger depend on any medication, make sure there's some onboard. Backcountry pilot Tom Dietz had another great suggestion: go out in your backyard for a night with just your survival vest and see what it's like to live with only the gear you have on you.

And most important to survival, as so many pilots reminded us, is to bring your PMA: positive mental attitude!



Conclusion

As a pilot, you do everything you can to prepare for survival. You follow safety protocols, file a flight plan, check weather reports, and try to fly over roads, valleys, and populated areas as much as possible. You study the best techniques for emergency landings. You carefully plan your survival kit and take survival courses. But what about your passengers?

In your plane, there's no flight attendant to give the safety talk and no safety card in the seat-back pocket. They're relying on you, and if you're injured in an emergency landing, you may be relying on them. So, they need to be informed and prepared to act. Here are some ways you can provide for their safety and yours:

- Make sure they're also wearing appropriate dress for the ground environment.
- Make sure they have cell phones with them that are fully charged.
- Brief them on how to exit the aircraft in an emergency, including ditching in water if that's a possibility.
- Make sure they know where survival gear is stowed, how to access it (if in cargo), and to get it out of the craft.
- Brief them on emergency procedures and pack written instructions, especially for comms equipment, in case they have to operate it. They should know where the ELT is and how to turn it on and how to set a SPOT device to SOS.

And with this, we wish you smooth flights and safe landings. May you always keep the pointy end forward and the blue side up.

Acknowledgements

Thank you to the celebrity judges, the contest winners, the contest participants, and our contributing pilot authors for sharing their wealth of knowledge and experience to help make the whole aviation community safer. With your help and insights, we are proud to publish this valuable resource, and while we hope no one has to rely on their gear in a genuine survival situation, we know they will be more equipped and confident if they do have to!



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