Emergency Procedures

Introduction

Practice, planning, and good judgment can improve the odds tremendously, but despite our best intentions, sometimes *things just go wrong*. In this Safety Advisor, we'll look at ways to handle those critical "up here, wishing you were down there" situations as safely as possible.

Note: The discussion of emergency procedures in this Safety Advisor is general in nature. There's no substitute for familiarity with the specific emergency procedures listed in the pilot's operating handbook (POH) or other aircraft-specific materials.

Definitions

What **is** an emergency? It seems like an easy question at first glance, but it's a little harder to pin down when you stop to think about it. Is an engine failure an emergency? What if it happens at 5,000 agl, in perfect weather, with 20 suitable landing spots within gliding distance?

In emergencies, context is everything. The location. The weather. The pilot. The airplane. The circumstances in which a problem occurs can make it a virtual non-event—or turn it into a nightmare (imagine that same engine failure at 300 agl during a night takeoff over a partially frozen lake).

Of course, in most cases the distinctions are more subtle. We'll use the term "emergency" quite a bit, but most of the problems that pilots face are more aptly termed "abnormal"—not business as usual, but not a source of immediate or grave danger. It's important to keep this distinction in mind. The ASF accident database contains numerous examples of pilots who managed to turn abnormal situations into emergencies. Whatever the situation, the pilot's guiding principle should be the same as the physician's: First, do no harm.

Initial Response

You're droning along in cruise when suddenly a problem arises. What to do? The first step should be to perform a very basic initial assessment:

1) What's wrong?
2) How critical is it?
3) How much time do I have?

The most dangerous situation is one that's both serious and requires immediate action. Engine failures shortly after

Although it's tempting to think that emergencies always happen to "other pilots," the truth is that none of us are immune.

If the engine failed here, the pilot would have plenty of potential landing spots. Twenty or thirty miles left of course, the situation would be entirely different.

takeoff, or oxygen system failures at 25,000 feet, come to mind. These are the kinds of issues for which pilots should be "spring-loaded." Significant time should be devoted to training for them, and immediate responses should be practiced regularly and (in the case of engine failure on takeoff) briefed prior to departure. Take this step seriously: Mindless recitation doesn't cut it.

Coming to grips: When confronted with an emergency situation, unprepared pilots have a tendency to work their way through several mental stages (shock, denial, acceptance) before finally taking action, wasting valuable time in the process. In a time-critical situation, those extra seconds can mean the difference between an acceptable outcome and something much worse.

On the other hand, it's equally important not to hurry if the situation doesn't call for it. Too many pilots get themselves into deeper trouble because they notice a problem that isn't particularly time-sensitive or critical and then act rashly to remedy it—for example, taking drastic measures to extend landing gear, or close a door that popped open in flight.

Troubleshooting

If the problem is mechanical or electrical, there's a chance that it won't be immediately obvious what's wrong. Given time, attempt to determine the cause—both because it might be fixable and on the chance that you can keep it from getting worse, or causing other problems. Study the panel and any other indications (smells, sights, sounds) and try to reach a conclusion. You might have to interpret information from multiple sources. For example: What if the oil pressure dropped to zero, but the engine continued to run normally and the oil temperature was steady?

Also remember that the situation may have been precipitated by something the pilot did, or failed to do. Into the category of self-induced emergencies fall such blunders as switching to an empty fuel tank (or forgetting to switch tanks) and grabbing the wrong power lever—mixture instead of throttle, for example. If the beginning of a problem coincided with something you did, undo it!

With respect to checklists: In an emergency, it's best to have the immediate action steps for certain situations—engine failure, fire, etc.—committed to memory. Once the immediate situation is under control, break out the checklist and verify that the proper steps have been taken. If need be, delve into further troubleshooting at that point.

Tip: Circumstances allowing, call for help! Declare an emergency: There's no good reason not to. Remember that you only need to switch to the emergency frequency (121.5) *if you aren't already in contact with ATC.*

Whatever the situation, one rule always applies: Fly the airplane! Troubleshoot, talk to ATC, calm the passengers—whatever you have to do…but remember that it's all for naught if you lose control of the airplane in the process.

Now that we've covered the basics, let's look at some specific situations in a bit more detail.

Emergency Situations

Engine Failure

If asked to name the first emergency situation that comes to mind, most general aviation pilots would probably answer "engine failure." That makes sense: Engine failures are the focus of much training and practice. But a real-life engine failure usually isn't the sterile exercise most pilots have come to expect when the CFI reaches over and yanks the throttle. The tach probably won't just drop to 1000 rpm and remain there. The engine will likely be shaking—violently, even—and there may be oil on the windshield. Smoke and fire are possibilities. In some cases, the engine may seize. In short, there's a "reality factor" that can make it more difficult to take the appropriate action.

Situations like this can be startling, but they don't call for extreme measures. Why make things difficult? Land the airplane and solve the problem on the ground.

Know when—and when not—to break out the emergency checklist. Initial responses to critical, time-sensitive problems should be memorized.

On the bright side, most engine failures don't just "happen." There's a good chance that the engine has been giving hints about its poor health in the hours leading up to the failure. Abrupt changes in oil consumption, unusual engine monitor indications, failure to develop proper static rpm, or unusual noises or vibrations are all worth investigating. Have a mechanic take a look: It might be inconvenient and expensive, but a forced landing will be worse!

If the prop stops (and there's fuel in the tanks), expect side effects—oil, smoke, and fire are possibilities.

Impending mechanical failures often reveal themselves over time, and can be prevented through good maintenance.

Partial Power Loss

An engine failure isn't always an all-or-nothing affair. In truth, a pilot is probably more likely to experience a partial power loss in flight than a complete failure. A number of things can cause a partial power loss:

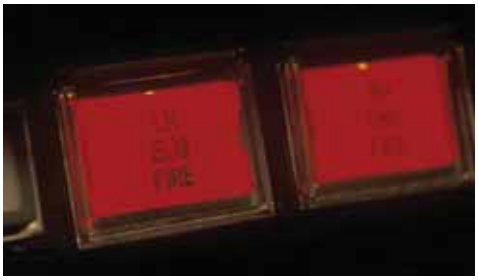
- Carburetor ice
- Failure to advance mixture on descent
- Valvetrain issues
- Cylinder/piston failures
- Early stages of fuel exhaustion/starvation
- Ignition problems

Whatever the cause, the engine may cease to produce sufficient power to maintain altitude, and it will probably be running rough. Unless the engine is threatening to tear itself off its mounts, it's probably best to leave the throttle alone, since changing the power setting introduces a new variable into a system that's reached a natural equilibrium of sorts. Proceed on the assumption that the engine could fail completely at any time: Head for the nearest airport and be prepared for a forced landing.

Fire

It probably goes without saying, but fire is one of the worst things that can go wrong in an airplane. When faced with smoke and/or fire, the pilot's primary goal should be to concentrate on flying the airplane safely to the ground as quickly as practical—even if that means an off-airport landing.

If there's electrical smoke in the cockpit, troubleshooting will likely involve shutting down all the electrical equipment and then bringing it back online, piece by piece. This can make it easier to trace the issue to a particular piece of equipment. On the other hand, if the circumstances don't require electrical power, it's best to leave everything turned off. Whatever the case, the basic advice is the same: If there's a significant amount of smoke in the cockpit, head for the ground. It's a good idea to have a small Halon fire extinguisher handy in the cockpit. A smoke hood may also be a worthwhile purchase.



If there's a fire, your first instinct will probably be to get the airplane on the ground. Follow it.

Although in many cases a whiff of smoke in the cockpit turns out to be nothing more than a minor electrical problem, it's best to err on the side of caution. Start preparing for a possible emergency landing before you spend a lot of time troubleshooting.

Cascading emergencies: If there's electrical smoke in the cockpit at night and/or in IMC, turning off the master switch could lead to other problems. Is there a flashlight (with good batteries) on board? How sharp are your instrument flying skills? Dealing with a potential fire is stressful enough by itself. Flying an airplane in the dark, or in IMC, with smoke in the cockpit can overwhelm even the best pilot very quickly.

Engine-related fires are equally serious: An immediate emergency landing is usually the best response. Some POHs recommend a sideslip to help "blow out" an engine fire, but don't count on this technique working. Shut off the fuel, make an emergency descent, and find a place to land. If fire reaches fuel tanks, or other critical parts of the airframe, the consequences could be dire.

Vacuum Pump Failure

A vacuum pump failure is a "Jekyll and Hyde" situation: If it happens in VMC, it's usually not a problem. In IMC, it's an entirely different story. For a pilot who doesn't notice a vacuum failure quickly enough and/or doesn't have good partial panel skills, the onset of spatial disorientation can be rapid. The results are usually fatal.

Simple annunciator lights like this make it much easier to recognize a vacuum pump failure. If you fly regularly at night, or in IMC, consider them essential.

There are three antidotes:

Recognition: In IMC, it's crucial to recognize the failure as soon as possible, and the tiny vacuum gauges in many aircraft aren't very helpful. Annunciator lights and other warning devices are more effective.

Redundancy: If you frequently fly at night, or in IMC, consider a backup vacuum system (or electrically driven backup instruments) essential equipment.

Partial Panel: Keep your partial panel skills sharp, and carry something—sticky notes, suction cups, dollar bills—to cover failed attitude and heading indicators.

Electrical Failure

Like a vacuum pump failure, the seriousness of an electrical failure is highly context-dependent. If it's night—or even *close* to night—carry a couple of good, reliable flashlights and extra batteries. It may also be wise to purchase a portable transceiver, and/or a handheld GPS. Remember, though: Backup equipment isn't much use if it's stowed deep in the recesses of the baggage compartment.

If your aircraft doesn't have warning lights for charging system malfunctions, include the ammeter in your regular instrument scan. Consider adding a warning light as your next upgrade.

For troubleshooting, check the obvious first. If the cockpit suddenly went dark, did you accidentally hit the master switch? If the ammeter is showing a discharge (or a zero reading on a load-type ammeter), the alternator may have tripped offline. Follow POH procedures for a reset. If the issue can't be resolved, start reducing electrical load to the essentials—particularly if it's night or IMC. Drop back to one radio and minimal navigation gear, shut down unnecessary lights, and turn off anything else that's drawing power. Stay in VMC if possible. If it's IMC, declare an emergency and divert.

Airframe/Control Problems

Unlikely though it may be, it's always possible for something to go wrong with the flight controls, or the airframe itself. The best advice for such situations seems to be: Do whatever it takes to keep the airplane under control. If the problem is serious and you have a parachute (either for yourself or for the airplane), think about using it. Otherwise, the situation will likely call for equal measures of care, creativity, and good luck.

Control failure: In 1989, a United Airlines DC-10 suffered an uncontained engine failure that, in an amazing stroke of bad luck, destroyed the aircraft's redundant hydraulic systems and deprived its pilots of all normal flight controls. Nevertheless, using nothing more than differential thrust from the two remaining engines, the crew was able to guide the aircraft to a runway. Although many perished in the crash landing that followed, the crew's improvised control technique and good teamwork helped save nearly 200 lives.

Landing Gear Problems

This is probably the most common "non-emergency emergency." Short of extraordinary circumstances, landing gear failures or malfunctions simply don't rise to the level of an emergency. Unfortunately, pilots often treat them as such…and end up causing bigger problems in the process.

Gear-up landings usually cause only minor damage. The aircraft in this photo was repaired and flying again in a matter of weeks.

Troubleshoot a landing gear issue within reason, but don't put the aircraft at risk doing so. Despite the intense scrutiny they often receive in the media, most gear-up landings are uneventful, highly survivable, and relatively damage-free. It's worth remembering that fact when tempted to try a "stunt" to get the gear down.

Weather

Weather-related emergencies are fairly common. The distinction between these and other types of emergencies, though, is that weather-related problems are largely self-inflicted. Solid basic weather knowledge, coupled with good aeronautical decision making, will stop most weather emergencies before they get started.

We won't discuss weather emergencies in detail here, but if you find yourself getting into a weather-related situation, remember that the best course of action may be to land immediately—*whether or not there's an airport beneath you!* Precautionary off-airport landings **are** a valid option. Although others will likely second-guess such a decision, the bottom line is that you (and your passengers) will almost certainly walk away from a precautionary landing. The same can't be said of a thunderstorm-related structural failure, or a "graveyard spiral" resulting from VFR into IMC.

Off-Airport Landings

Here are some tips that might prove helpful should you ever need an "impromptu airport."

Stretching the Glide

If the aircraft has lost engine power, making it to a suitable landing area is a key concern, and that means maximizing the glide. Doing this boils down to airspeed control. It's imperative to first get the aircraft close to best glide speed, and then trim for that airspeed to make it easier to maintain while you're busy with other things. Remember that best glide airspeed generally decreases with weight: If the aircraft is light, subtract a couple of knots from the published speed, which is usually close to Vy.

Propellers are another issue. A windmilling propeller adds drag, decreasing the glide performance of the aircraft. In most multiengine aircraft, pilots can solve this problem by feathering the "dead" propeller. Pilots of single engine aircraft don't have that option, but if the airplane has a constant speed propeller (and enough oil pressure), putting the propeller control in the low-rpm (aft) position will increase the blade angle and in many cases give a noticeable improvement in glide performance.

Feather the "dead" propeller in a twin after verifying that the engine has indeed failed. At low altitudes or airspeeds, it may be necessary to feather immediately.

At the other end of the spectrum are situations that require a rapid descent. If the situation warrants it, don't be shy about exceeding flap and/or gear speed limitations in an effort to slow down and go down quickly.

The "nearest airport" function on GPS receivers can be a great tool when searching for a landing spot within glide range, but as with any technology, it has limitations. If winds aloft are strong, for example, the nearest airport may actually be harder to reach than a more distant field that's downwind of your position.

Tip: When taking advantage of a strong tailwind to reach an emergency landing spot, remember to allow room to perform an upwind turn prior to landing. Also remember that some private airports may not be in the GPS database, so look around a bit before fixating on the airport the GPS says is closest.

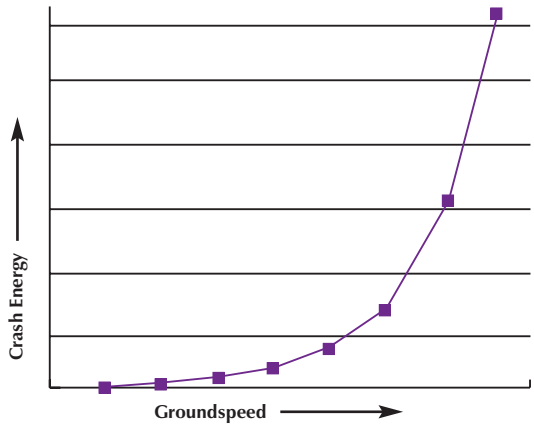
This crop duster came to grief after a forced landing in a cornfield. If possible, avoid fields with tall crops.

Choosing a Field

In much of this vast country, an off-airport landing means choosing an open field. But one field is *not* just like another. Furrows in plowed fields can be quite deep—enough to flip an aircraft landing across them. Likewise, tall crops (fully grown corn, for example) can also cause a rollover.

In many cases, pilots are faced with a dilemma: field or road? Although a road may be tempting at first glance, there are good reasons to be wary. Traffic is one of them. Try not to impose *your* emergency on innocent bystanders: If you collide with a car, you've failed in that endeavor. Also remember that roads have bridges, are sometimes narrow, and are often flanked by power lines. In most cases, if faced with a choice between a "sure thing" field and a "maybe" road, you're better off with the field.

Speed and Energy: In an off-airport landing, even relatively small changes in groundspeed can have major implications for crash survivability. Avoid downwind landings if at all possible. A tailwind puts you in "double jeopardy": 10 knots of tailwind equals 20 knots of extra groundspeed compared to a landing in the opposite direction. The extra 20 knots requires much more room for landing, and means that **much** more energy will be involved in a possible crash.



Energy increases with the square of speed. A 60-knot landing is only 50 percent faster than a 40-knot landing, but involves 125 percent more energy.

Night

Unfortunately, there's a lot of truth in the old joke about forced landings at night: "Turn on the landing light: If you don't like what you see, turn it back off."

Still, we can offer a few suggestions. First, moonlight can provide a surprising amount of illumination (particularly with snow on the ground), so it may be wise to avoid dark "new moon" nights if possible. Likewise, being familiar with the area over which you're flying will give a better idea of what awaits during a possible emergency landing. Also consider that well-lit areas, though tempting, are certain to contain obstructions like power lines. In some cases—particularly in mountainous areas—the best idea is simply to wait for daylight before taking off.

Preparing for Landing

Having chosen a landing spot, it's time to make sure that the aircraft and its occupants are prepared for the landing.

The moment of truth. Low airspeed is preferable in off-airport landings, but don't stall the airplane trying to achieve the slowest possible touchdown.

Check that passengers are belted in tightly and know how to open doors and other escape routes. It's a good idea to pop a door prior to landing: If the airframe distorts, this will keep the door from being wedged in the "closed" position. To ensure that the door doesn't re-latch itself prior to landing, move the handle to the "closed" position or wedge something into the gap. Also verify that the seats are locked in position.

Depending on the situation, it may be wise to shut off the master switch just prior to landing. This can help lower the risk of a post-crash fire. For the same reason, double-check that the fuel selector is in the Off position if the engine has already failed.

Landing Gear? If the aircraft has retractable landing gear, should it be up or down for an off-airport landing? The answer: It depends. If the landing spot is an empty eight-lane highway, it probably makes sense to drop the gear. But it's not always so clear-cut. If the ground is soft, for example, the gear might dig in and cause the airplane to flip over. On the other hand, it might absorb some of the energy of a crash, or help stop the aircraft if space is limited. Bottom line: Use your best judgment, and remember that in most cases it's not a "make or break" decision.

Survival

It's simple: If the aircraft goes down in a harsh environment, or if there are injuries, the best way to survive is to be found by search and rescue personnel. One of the easiest ways to make this happen is to file (and activate) a flight plan: It guarantees that someone will eventually be looking for you.

In most cases, it's wise to stay near the aircraft if the area is unfamiliar or remote, or if the weather is bad. This is true for a couple of reasons. First, as a general rule, it's easier for search parties to find a downed aircraft than a person. Second, the aircraft will probably provide at least *some* shelter against the elements.

Also remember to dress appropriately for the weather/temperature in the area over which you'll be flying. In the winter, that means wearing (or at least bringing) heavier clothes, mittens, and hats. If the planned flight will take you over inhospitable/remote areas, consider bringing a survival kit and rations. What to bring depends on the circumstances: Pre-made kits can be purchased from various outdoor retailers, and AOPA has information for members who wish to build their own.

Cell phones: Keeping a cell phone on your person (or at least in a position in which it could be turned on in the event of a forced landing) is one way to increase the chances of survival after an off-airport landing. This is true both because it might let you call for help and because the position of a "live" phone can sometimes be determined through triangulation based on its communications with cell towers.

ELT Options

One item many pilots count on to help searchers locate them after a crash is an ELT (Emergency Locator Transmitter). Unfortunately, the 121.5 mhz ELTs installed in most general aviation aircraft perform poorly. The vast majority of signals are false alarms, and the nature of the system means that it can be several hours before a real signal is even received. Even then, the search area may be quite large.

An ideal survival kit is comprised of high quality components, and is customized for the terrain, season, and climate.

Pilots looking for a better alternative should consider upgrading to a 406 mhz ELT. These units define a more precise search area, and do it much faster. Some are GPS enabled, and can provide a pinpoint location. Another alternative is a Personal Locator Beacon (PLB). Although they have certain limitations as compared to 406 mhz ELTs, they work in much the same way. Bear in mind, however, that PLBs have to be manually activated.

121.5 Satellite Monitoring: After February 1, 2009, the satellite system that monitors 121.5 mhz ELT signals will cease to serve that role. Although still legal, after that date 121.5 mhz ELTs will provide very limited assistance in the event of a crash. At present, the FAA is not expected to mandate replacement with 406 mhz ELTs.

Summary

There's no way to be totally prepared for every emergency situation, but there **are** ways to significantly improve your odds of surviving one. It's been demonstrated conclusively that preparation predicts performance when the real thing happens. A NASA study of airline crew performance, for example, found that 85 percent of "textbook" emergencies (those that the crews had trained for) were handled well, while only seven percent of "new" emergency situations were handled with the same degree of success.

The other good news is that many (if not most) emergencies are avoidable simply because they're set in motion by the pilot. Flight into icing conditions. Thunderstorm encounters. Fuel exhaustion. In situations like these, the airplane usually isn't the guilty party. Manage risks wisely, practice good aeronautical decision making, and actively prepare for events over which you have less control: You'll be less likely to have an emergency, and more able to cope with one.

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