Flight Training Magazine: Emergency Landings

Differentiating precautionary landings, forced landings, and ditching

By Robert N. Rossier

When an engine quits — and won't restart — the next step is an emergency landing. There are three types of off-airport landings. Precautionary landings are made with power in anticipation of a real emergency. Forced landings are made with a dead engine. And a ditching is a forced landing in water.

The important distinction between the three is their fatality rates. The rate for precautionary landings is 0.06 percent. If you recognize a developing engine problem and can make a precautionary landing, you and your passengers will likely survive. The fatality rate for forced landings is roughly 10 percent, more than 1,600 times greater than precautionary landings. Ditchings have the worst rate, about 20 percent.

Precautionary advantages

Precautionary landings offer several advantages over forced landings. You can use power to reach an airport or landing site beyond your gliding distance or to compensate for errors in judgment or technique. If a problem is developing, it might be wise to expedite a precautionary landing. Delaying it could result in a forced landing, as the pilot of a homebuilt Bowers Fly Baby learned.

The aircraft lost partial power while cruising near Conneaut, Ohio. The pilot decided to circle a field below and land. The engine lost all power just after his second pass and while on downwind. The aircraft crashed short of the field, striking a berm beside a road. The aircraft was destroyed and the pilot sustained serious injuries.

Not all engine problems provide time for a precautionary landing. Pilots sometimes have to play the hand they're dealt. In a booklet titled "How to Crash an Airplane (and Survive!)," FAA Aviation Safety Program Manager Mick Wilson of the Denver Flight Standards District Office makes a number of excellent points regarding off-airport landings.

Controlled crashing

As long as the aircraft is kept under control, Wilson says, slower is safer. Excess speed translates to substantially higher impact energy. To make a survivable forced landing, approach the ground and obstacles just above stall speed.

Psychological considerations are also important. The outcome will likely be better if you accept and deal with the emergency rather than trying to avoid the inevitable. Pilots attempting dangerous maneuvers to avoid off-airport landings often become statistics. Such may have been the case in the following accident.

A Beech A23 Musketeer took off from Runway 27 at Simmons Field at Fort Bragg, N.C., and climbed to approximately 300 feet, where the engine apparently lost power. After requesting an immediate landing, the pilot made a 90-degree-bank turn to the right, lost control, and crashed on a heading of about 030?. The pilot and passenger died in the post-crash fire.

Saving the cockpit is the primary objective in a forced landing, Wilson says. Using dispensable aircraft structures, such as the wings and landing gear, to absorb the impact energy makes this possible. Ground objects, such as fences and small structures, also absorb energy.

When there was no other place to go, many pilots have made successful emergency landings by flying aircraft slowly and under control into treetops. Smaller trees, brush, and vegetation can also help decelerate an aircraft and absorb the impact, a fact that saved a quick-thinking Piper Tri-Pacer (PA-22-150) pilot.

The engine quit at 150 feet after the Tri-Pacer departed from West Plains Municipal in Missouri. The pilot turned to avoid the trees at the end of the runway and, to soften the impact, landed in a thicket of 6-foot briars and blackberry bushes. Neither the pilot nor passenger suffered any injuries.

When planning any emergency landing, assessing the wind direction and speed and the selected site's length and slope is essential. A large field isn't always necessary. A survivable (9-G) deceleration from 50 miles per hour requires just under 10 feet of landing distance, Wilson says. As the following accidents illustrate, a clear approach zone and maintaining control of the aircraft are more important than a perfect touchdown area.

The pilot of a Cherokee 140 near Edgewater, Md., radioed air traffic control (ATC) that he had only partial power. ATC vectored him to the closest airport. Although the stiff wind favored Runway 30, the pilot elected to land downwind on Runway 12. He made things worse when he decided to go around and circle to Runway 30. The aircraft entered a climb, banked steeply to the left, and crashed through power lines. The pilot was killed and the passenger was seriously injured.

A Cessna 172 was cruising Houston, Texas, when the engine quit due to a faulty carburetor. The best landing site available was a small field near some houses in a heavily wooded area. The aircraft touched down, rolled about 500 feet, and crashed into the trees. The pilot was uninjured.

When sizing up an emergency landing site, it's often better to select an area with a clear approach zone, even if the field is rough or there is a slight tail or crosswind. Striking objects on the ground at relatively low speed is much safer than hitting them while airborne at higher speeds.

Emergency training

One problem with making forced landings is that pilots may be unintentionally biased by their training. For safety reasons, instructors use a good field when practicing emergency landings. In the real world, Murphy's Law almost guarantees that an engine failure will occur at low altitude over inhospitable terrain. If pilots have been conditioned to think that a reasonable landing site is always available, they may not react appropriately in situations that have no reasonable alternatives.

While simulating engine-out emergencies where no obvious landing sites exist might better prepare pilots for real emergencies, engine-out training itself is risky business. Simulations can become real when pilots attempt to recover from the maneuver.

An instructor retarded the Cessna 150's throttle to simulate an engine failure during the initial climb after takeoff. The student maneuvered the aircraft in response to the simulated emergency, but neither he nor the instructor applied carburetor heat. The simulation completed, the instructor added power to recover. The engine coughed and stopped. The instructor made a forced landing in a grain field. Neither occupant was injured, but the aircraft was substantially damaged.

Confounding configurations

The best aircraft configuration for a forced landing is a hotly debated topic, especially when it comes to landing gear position. In rough, hard terrain, putting the gear down to absorb impact energy may be advantageous. This advantage is lost if the aircraft flips, since the best seat restraints can't adequately protect people from the omnidirectional forces resulting from a tumbling cockpit. Most experts agree that the gear should be up for landing on soft surfaces, on snow, and in the water.

There is no argument regarding the electrical and fuel systems — secure them to reduce the potential for a post-crash fire. And bank angles should be nonexistent to shallow to avoid catching a wingtip and cartwheeling the aircraft.

Ditching basics

Wind speed and direction and "terrain" are important considerations when ditching. On large, open bodies of water, pilots must consider both swell and sea direction. Swells are often larger than the prevailing wind-driven seas. They can be in an entirely different direction from the seas, complicating the choice of landing direction.

Pilots must assess wind direction and speed with respect to the aircraft crosswind capability to determine the best direction for a ditching. It's best to land into the wind and parallel to the swells, but this is not always possible. If the winds are less than 25 knots, landing parallel to the swells may be possible in a crosswind.

Higher wind speeds and crosswind limitations might force you to land at an angle to the swells. Once winds exceed 35 knots, swells and seas will likely be in the same direction. Although the waves may be high, landing into the wind will minimize ground speed and lessen the impact should you miss the top of a wave and crash into an oncoming one.

Beaches with long, straight stretches, where you can land on wet, hard sand, are attractive landing sites. Unfortunately, these beaches are often covered with people. The only alternative in such a situation might be to land offshore. Remember to touch down beyond the breaking waves; landing in high surf often overturns the aircraft, trapping the occupants. If you're near islands, land along the lee shore where seas and swells are smaller.

The greatest challenge in surviving a ditching is not the landing. Hypothermia, the reduction of body temperature, claims nearly half the victims of ditchings. If you're over open water, look for boats and land near one to get assistance. If you can, overfly the boat to attract attention before ditching.

If flying over water, you should have the necessary survival equipment. At the very least, have flotation devices. Without them, staying afloat until help arrives might be impossible. Don't count the airplane. A ditched aircraft may not float for long.

An instructor and a student departed from St. Petersburg, Fla., in a Piper Tomahawk (PA-38) and were climbing through 300 feet when the engine lost partial power. The engine failed as the instructor was turning back to the airport. He leveled the wings and ditched in Tampa Bay. The Tomahawk sank 10-15 seconds later. The instructor and student were rescued by passing boats.

There are few things more frightening than forced landings. But with proper training and planning, they can be made without serious injury. The most important thing to remember is the first rule of aviation: No matter what, always fly the airplane.