ZERO ENGINE APPROACH

Few things strike more fear in the heart of an instrument pilot than losing an engine in IMC. But you can minimize the impact of an engine failure.

By Harry Kraemer

Flying over mountains, at night and in IMC in a single-pilot, single-engine operation can be a lonely place. With the lack of visual cues, the hum of the engine isn't a hum anymore. The engine sounds irregular, a spit and sputter here and there gets your attention. You start to imagine engine noises or you stare at a gauge thinking it's slowly moving towards the danger zone. Your scan seems to shift from the flight instruments to the engine gauge cluster, which becomes more of a stare. When confronted with a life-threatening situation, such as an engine failure, a state of denial is often the first response. This is a single-engine driver's worst nightmare: an engine failure, at night, in low IMC and over mountainous terrain.

But it can be survivable by stacking the odds in your favor.

Let's look at an unfriendly, mountainous IFR route, and we'll throw in some low IMC at night.

IFR from Colorado Springs, Colo., to Los Angeles, Calif., takes you over some of the roughest terrain in the country. The weather is lousy from about 2,000 feet above the ground through your cruising altitude. During the climb, you noticed that the oil temperature gauge was reading a little higher than normal. You try to convince yourself that this is due to the prolonged climb. But is it? After leveling off at your cruising altitude, you notice that you cannot get the power that your operating handbook shows for this altitude. Is this another sign that trouble is just ahead? Now the oil pressure is showing low.

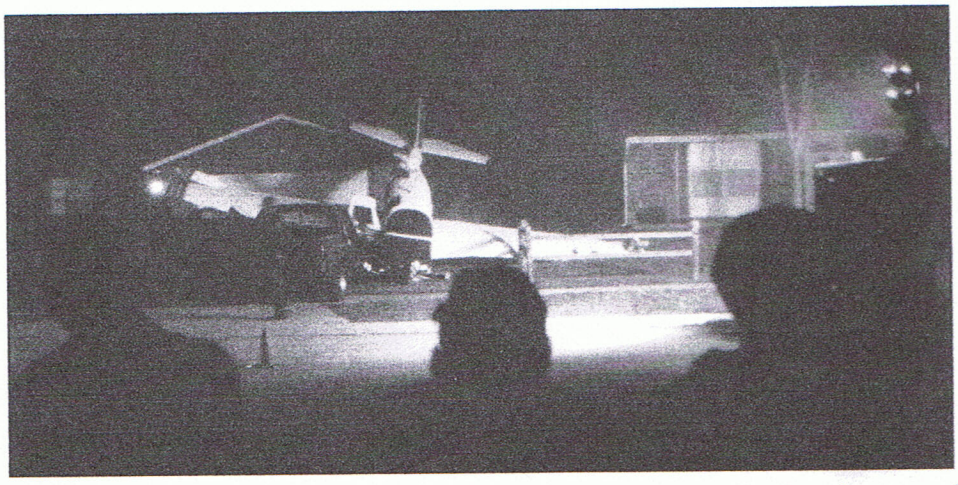
And as you think to yourself "This can't be happening to me", the engine goes dead. The silence is deafening. Training and mental preparation comes into play here.

Options And Resources

If you're lucky enough to be flying an aircraft equipped with a GPS, you'll be able to use the nearest airport feature. Some of the more advanced glass cockpit systems display a glide range. Combine this with the nearest airport feature and you can quickly tell if there is an airport within range. Your GPS can also show you where not to land. For example, depending on circumstances, you may or may not want to land on a lake or in a river (lakes and rivers are displayed on most GPS units). Most GPS units also display roads and highways. Depending on the time of day, a road or a highway may or may not be a suitable place to set it down. Some GPS units will constantly update the nearest airport. With a dual GPS panel, you may want to keep the second GPS in the nearest airport mode so that you'll always know where the nearest runway is.

During the summer months, a lake or river may be a suitable place to set it down. Rivers are usually not overgrown with trees, so there will be a clear path down to touchdown. The water of the river and/or lake will be level as compared to the jagged terrain of the surrounding mountains. During the summer months, your odds of surviving a water landing are good. During the winter, though, hypothermia caused by the frigid water can be deadly. This becomes a concern if you don't know whether or not the river or lake is frozen over or if the ice can withstand the weight of the aircraft.

But the biggest resource is the person on the other end of that radio. Let the controllers know immediately that you have a problem or suspect that one is imminent and don't be afraid to declare an emergency. Many pilots have gotten themselves hurt or killed because they either waited to long to tell the controllers what was happening or they didn't adequately convey the seriousness of the situation. Controllers can help you get to a nearby airfield or describe the topography if you're over unfriendly ter-



A house and truck are certainly not the things you want to see when you bust out of clouds with no options. Still, most crashes like this are survavable.

ritory. Sometimes, another pilot on the frequency can provide help by sharing knowledge of the local terrain or by suggesting areas where the weather is better. Remember, you may be the only person in the plane, but you're never alone.

Trim Is Your Friend

Trim the aircraft for best glide speed. This is perhaps one of the most important resources available in a situation like this. Trimming the aircraft will free you up allowing you to utilize your resources while lessening your chances of getting too slow or fast. It'll also free you up to do some trouble-shooting. Your actual best glide speed is affected by many factors and can be roughly calculated by the following steps:

1. Establish a relatively high rate of descent.

2. Slowly trim the nose up and watch the vertical speed indicator — the rate of descent will be decreasing.

3. Continue to trim the nose up until the VSI starts to increase again. Just before the increase began is your best glide speed.

The above method is not exact, but it will get you in the ballpark if during the workload of the engine failure you've forgotten the published best glide speed.

A descent through an area of icing and/or freezing rain requires a different thought. Instead of descending at best glide speed, you'll have to increase your descent rate. This could be a significant increase in airspeed. Pay attention to the flight controls. Any "slop" or "play" could mean that you are getting close to a stall. The higher airspeed will also get you through the ice faster with less accumulation.

Cause and Prevention

Most partial or complete engine failures give subtle warnings that can alert you to trouble brewing. It is very important to monitor your engine gauges for any change from the normal. Just being in the green doesn't always mean that everything is okay. For each aircraft you fly, learn where the various engine indicators normally settle. Another visual clue on the engine gauges that something is about to happen is a lowering oil pressure with rising oil temperatures. This is usually a sure sign of an impending catastrophic engine failure.

Weather conditions can also be the cause of engine failures, though they are usually easy to fix. The most likely cause of a partial or complete engine failure while in IMC in a carburetor-equipped plane is carburetor ice. Be especially aware of carb ice when flying with outside air temperatures between 20 and 70 degrees Fahrenheit. It is recommended that carb heat be applied and left on while in conditions likely to cause carb ice. And unless you have a carb temperature gauge, full carb heat is recommended. The use of partial heat has been known to actually create conditions of carb ice.

If the engine has actually stopped running completely because of carb ice, a restart using the starter will usually be necessary. However, use the starter with caution, since draining the battery while attempting a restart at altitude will just create another problem: a dead engine and no electrical systems. Being able to identify the cause of the failure can help you decide whether to attempt a restart using the starter. In the event of an engine failure, you **do not** want to drain the battery trying to restart.

Pay close attention to structural icing, which could lead to induction icing and the loss of partial or complete power. If flying a fuel-injected aircraft, watch for the slightest change in manifold pressure and/or RPM, as this may be a sign that induction icing is occurring. First, select your alternate air source. In carbureted planes, this is usually your carb heat. Second, change altitudes to get into warmer air. During your preflight briefing, look for temperature inversions. Understanding the type of precipitation and how it is formed will help in deciding whether climbing or descending will get you into warmer air. For example, ice pellets or freezing rain will usually mean that there is warmer air above you. That's not to say that there isn't warmer air below you, but over mountainous terrain, descending for warmer air may not be an option.

Sometimes the hardest decision for a pilot to make is to commit to an off-airport landing even though the engine is running, but only producing partial power. Your thoughts change from trouble shooting the problem, to "Can I make it to the airport up ahead?" It is during this critical decision segment that we must still continue to trouble shoot the partial power loss. There is a chance that the problem can be resolved. With a complete engine failure, the decision to land has been made for you, but the

Trees or Water: Take Your Pick

The best place to dead-stick an airplane is obviously on a runway. But that may not be an option.

So given the choice between trees or water, it might seem obvious to pick the later. But research done by our sister publication *Aviation Safety* shows that whichever one you chose, it's a wash.

In a review of 179 ditchings and 216 forced landings over a three year period, the results showed that the odds of surviving either type of landing was around 90 percent.

What the analysis did reveal was the risk of injury was higher when into the trees than in the water and the risk of serious injury was even higher, which only makes sense.

Not surprisingly, the data also showed that speed kills, or at least hurts. Many forced landings went from bad to worse when the airplane overshot the field or ran out of room.

Slower speeds also lessen the impact energy that's absorbed by the airframe and passengers on board. This is especially important in tree landings where controllability isn't an issue anymore as the airplane sinks into the branches.

—Bill DeBrauwer

partial failure or loss of power is a little more complicated.

With a partial power loss analyze the situation carefully. How much power has been loss? Can you still maintain altitude? If you can't maintain altitude, what is the rate of descent? Is the engine stable now? If a rough calculation shows that you can make an airport, head towards it as long as you have plenty of options below you along the way. With certain engine problems, the power loss is very minimal if any at all — just a rough running engine. If this case, it may be wise to stay at altitude for as long as you can and spiral down once over an airport.

A precautionary off-airport landing under power or even partial power in VMC is a lot safer than a dead stick landing over inhospitable terrain in IMC. So if visual or aural indications are suggesting that an engine failure is imminent, an off-airport landing under power may be a better alternate than waiting for it to fail completely.

It is also important to have a good understanding of the various systems of the aircraft. If the aircraft is pressurized, an engine failure may mean that you will also loose cabin pressure, meaning that you need to go on the emergency oxygen while descending to a lower altitude. In addition, with a complete engine failure, you'll probably loose the main vacuum pump. If you don't have a backup, you now have a dead engine and are flying partial panel.

Special Planning

Planning ahead for all of the little "gotchas" can surely pay off. For example, if you fly IMC over unfriendly terrain or weather in an aircraft that only feeds off one tank at a time, switching every 15 to 20 minutes instead of the usual 30 to 60 minutes will alert you to a fuel flow problem or fuel selector problem. There was an incident where a Mooney pilot was flying in the clear above an area of severe icing. When he reached down to switch tanks the selector broke off in his hand. The selector was now stuck on the tank he had been using for the last hour while the other tank was full of fuel. So he was literally running out of gas with a full tank. Switching tanks more frequently will alert you to such a problem earlier and give you a little more fuel to divert.

Another special planning item would be to plan your route so it passes over more airports. When ATC clears you direct to a waypoint, reevaluate the route and if necessary, decline the short cut.

A Survivable Landing

For most off-airport landings, touching down at the slowest possible speed is paramount. This is critical if you know you are going to be landing in the trees. It's the forward momentum rather than the vertical speed that can cause greater injury. If able, right before impact slow the plane to a speed just above a stall, but making sure not to stall the airplane.

Harry Kraemer is a Gold Seal flight instructor who holds three Master CFI titles from the National Association of Flight Instructors. He's also an Aviation Safety Counselor with the Baltimore FSDO.

Equipped To Survive

Walking away from a crash may only be half the battle. Terrain, weather and injuries all play a factor in determining the survivability of an airplane crash.

Fortunately, pilots can take certain steps to stack the odds in their favor. The easiest is to carry a survival kit as standard equipment on the airplane.

There are several commercially-made survival packs available on the market. Outdoor sporting goods stores are good place to start.

Another good source is Douglas S. Ritter's Equipped to Survive website at **www.equipped.org**. It includes articles on survival techniques, tips on making your own survival kit and links to commercially-available products.