The Proficient Pilot

Volume 1

Barry Schiff

Foreword by Ernest K. Gann

Aviation Supplies & Academics, Inc.
Newcastle, Washington

Chapter 35 **Engine Failure at Night or When IFR in a Single-Engine Airplane**

Is there a prospect more chilling than an engine failure that occurs while flying at night or IFR (or both) in a single-engine airplane? A daytime failure is serious enough but generally is survivable. At night or when above a low ceiling, the same emergency can be catastrophic.

Pilots are trained to cope with engine difficulties during daylight VFR conditions. Who hasn't had an instructor pull the throttle to simulate engine failure? It catches us by surprise but is not alarming, because the engine really isn't dead. And isn't every multi-engine pilot trained to manage a twin on one engine?

These exercises are reminders that although the modern piston engine is superbly reliable, it can fail, and we need to be prepared for such a possibility. Paradoxically, however, we are taught nothing about handling a similar emergency at night or when IFR. The subject is virtually ignored.

The military, however, offers this advice to its single-engine pilots: "If the engine fails at night or when above a low ceiling, bail out."

One fatalistic instructor offers this suggestion about an off-airport, dead-stick landing at night: "When you get to within a few hundred feet of the ground, turn on the landing lights. If you don't like what you see, turn 'em off."

Fortunately, engine failures are remarkably rare, but they do occur, however infrequently. When taking off into an ebony sky or a low ceiling, the possibility must be considered.

A pilot who flies single engine at night or over an extensive area of low cloudiness does so because of his faith in the engine. Every hour, every day, and every year of uneventful flight reinforces this belief. Experience tends to isolate a pilot from the concept of engine failure.

But should such a failure occur while he is enshrouded in darkness or cloud, he might have difficulty overcoming the shock of such cruel reality. He has had little or no preparation for the cataclysmic, terrifying silence. Plane and pilot simply descend helplessly toward an uncertain fate.

This is not intended to frighten night pilots or those who fly extensive IFR in single-engine airplanes. Rather, the purpose is to focus attention on the reality that an engine can fail at any time, which dictates the need for preparation at all times.

Preparation begins with planning. Unless a pilot is willing to bet his life (and those of his passengers) that his engine will not fail, flights should be avoided over areas of very low ceiling and visibility. There should be enough maneuvering room beneath the clouds for a pilot to locate a landing site of his choice. Descending blindly and powerless into zero-zero conditions puts lives totally in the hands of fate.

This is because an emergency landing is generally survivable only when the pilot can control the aircraft and select the softest point of impact; crash landings in the blind usually are terminal.

If a flight over extensive fog cannot be avoided by selecting an alternate route, consideration might be given to postponement until conditions improve.

Remember that although enroute stations might be reporting a 1,000-foot overcast, for example, hilly or mountainous terrain between those stations might rise to above the base of the overcast or higher. Flying above a 1,000-foot ceiling might be safe when over the Great Plains, but not necessarily when over the Alleghenies or the Rockies. The character of enroute terrain should be considered.

Night flying also requires planning that enables a pilot—in case of engine failure—to see the projected landing area.

This, however, is not a universally held opinion. Many pilots—professionals included—prefer gliding into a “black hole” instead of landing in

an illuminated area. Their theory is that a dark spot is probably undeveloped and, therefore, reasonably flat. Landing "in the lights," they claim, offers a greater risk because of automobiles, structures, and other man-made obstacles.

Others (myself included) disagree because of our reluctance to plunge blindly and unexpectedly into a boulder, ravine, or unlit structure. When he can "see" impending obstacles, a pilot is at least able to point the aircraft in the least damaging direction and direct the wings to absorb the initial shock in an attempt to preserve the fuselage and its fragile contents.

A multilane highway is a popular haven for powerless pilots. Admittedly, however, these lengthy "runways" were more suitable when the speed limit was higher. The best technique suggests landing into the wind (if possible) and with the traffic. Descend to a point between two cars and begin a speed reduction (flare) before settling between them. Hopefully, the driver of the car behind will see the aircraft and decelerate. As groundspeed decreases, the car in front should pull ahead of the airplane leaving sufficient room for a safe landing (power lines and bridges notwithstanding).

If highway traffic is heavy and slow, land elsewhere.

Another good alternative on a dark night is a body of water located by lights reflecting from its surface. Ditching near the edge of a body of inland water offers a high probability of survival, even to nonswimmers. The idea is to escape the crash; worry about subsequent problems later. (When ditching in a river, land with the current, not against it, unless strong winds dictate otherwise.)

If a landing must be executed on totally dark terrain, select a spot as near to civilization as possible. This increases the likelihood of early rescue and medical attention.

Soaring over a carpet of lights under a mantle of black sky can be intensely rewarding—an aesthetic, introspective experience. But night

flying requires unique considerations. Paramount among these is route selection. To maximize safety, courses should be altered to follow major highways, fly over or near as many enroute airports as possible, and avoid extensive areas of totally dark terrain. This latter point is particularly important over mountainous terrain. An engine failure here could find a pilot gliding unwittingly toward the Grand Canyon or trying to bore a hole in Mt. Granite. A near-full moon is particularly helpful when flying single-engine aircraft at night.

Once under way—whether at night or when on instruments—a pilot must be acutely sensitive to the behavior of the powerplant and related systems. At the first indication that something might be amiss, proceed to the nearest airport. Minor discrepancies that might be acceptable on a daytime VFR flight can be totally intolerable at other times.

Fortunately, most power losses are only partial engine failures. With the exception of fuel exhaustion, it is unusual for an engine to quit without warning.

Should a partial loss occur, proceed to the nearest suitable landing area (which might or might not be an airport) and land as soon as possible.

The most horrendous situation is, of course, total power failure at night or when IFR. Your most immediate and pressing adversary is panic because of its detrimental effect on pilot performance. Contrary to initial reaction, you will not be helpless. There are many factors to consider and actions to take. These require as unencumbered a mind and body as is possible to organize. Difficult as it might be, calm down. Take a deep breath and get to work.

The first step is to determine if you have really had an engine failure. Sound silly? It's not. A massive power loss might feel like total failure, but the engine could be producing sufficient power with which to either maintain altitude or hobble toward a nearby airport in a gradual

descent. Juggle the engine controls in an attempt to find a combination that maximizes available power.

If the engine has failed totally and attempts to restart it are fruitless, then you are faced with a full-scale emergency and have precious few moments to consider many variables.

The first step involves establishing the proper priority: aviate (fly and maintain control of the airplane!), navigate, and then communicate. The latter involves (1) turning on the emergency locator transmitter (don't wait for a crash to activate this electronic plea-for-help; the internal switch may fail to operate), (2) selecting the emergency transponder code (7700) post haste, and (3) attempting to establish voice communications with a radar facility that could vector you to a nearby airport.

Incredibly, an IFR pilot gliding through cloud can (either alone or with radar assistance) execute a dead-stick, IFR approach to a safe landing. Yes, it has been done.

I recall once surprising an advanced instrument student (who was wearing an IFR hood) with a retarded throttle. Because he had an abundance of altitude, he was able to orient himself, select the appropriate approach plate, and guide the aircraft to the threshold of a nearby airport. The trick, we concluded, was to remain substantially above the minimum crossing altitudes shown on the approach plate until reasonably close to the airport. Curiously, and using a technique described later, such a feat is easier when the engine is really dead and not just idling.

A dead-stick, IFR approach may not be successful, but there's not much to lose by trying. When engulfed in cloud, where else is there to go?

A major consideration (at night or in the clouds) is the vacuum instruments (the gyroscopic attitude and direction indicators). Without engine power, the vacuum (or pressure) pump might produce less than the minimum airflow required for proper gyro operation. As an unpowered descent continues, be on guard for erroneous attitude information (or tumbled gyros!) by cross-checking the electric turn coordinator or indi-

cator. Rapid and large attitude changes should be minimized. Maneuvering adds precessional forces to gyroscopic instruments that makes them even more unreliable when the vacuum pump has marginal output.

Gyro failure is a serious problem not only when IFR, but also perhaps when VFR at night. Although the horizon might be visible at altitude, it could disappear from view during descent because of terrain irregularities.

The electrical system also warrants attention. When the engine fails, rpm decreases to less than that required for generator operation. Windmilling rpm, however, usually allows an alternator to carry the load. Therefore, if the aircraft is equipped with a generator and not an alternator, only battery power will be available.

Batteries, however, are severely weakened when coldsoaked at high altitude or when exposed to winter temperatures. Consider that at 32 degrees F, a fully charged, lead-sulphuric acid battery loses 35 percent of its stored energy; at 0 degrees F, 60 percent of its electrical potential is lost. And this assumes a healthy battery. If the battery is cold-soaked and weak to begin with, electrical power could be in short supply.

To prevent total electrical loss during an engine-out descent, it is important to reduce electrical load as much as possible. Turn off everything that isn't essential. When transmissions are made, keep them brief and to the point. Avoid using landing lights until close enough to the ground for them to be useful.

If your aircraft utilizes an engine-driven hydraulic pump to extend the landing gear and flaps, consider that when the propeller is windmilling, there might not be sufficient hydraulic pressure available to extend the landing gear prior to landing. Save enough time for a manual extension.

Pilots have been trained since Year One to glide at the best angle-of-glide speed. This is fine if trying to reach some distant point. But if there are no airports within gliding range or if a pilot cannot find a landing site (because he is still in cloud), then he has an alternative.

By reducing airspeed to about stall speed plus 10 or 15 knots, sink rate decreases dramatically. This slower airspeed is familiar to all glider pilots as the "minimum-sink speed." True, the airplane does not glide as far (horizontally), but this speed does substantially postpone ground contact. This allows more time to communicate, more time to calm down, and more time to select a landing site.

If the terrain is so dark or the clouds so low that a pilot must land "in the blind," such reduced speed and sink rate also reduce impact forces (vertical and longitudinal Gs) and increase survival probability.

When and if the pilot finally sees a place to land, airspeed should be adjusted to a normal approach speed (when no lower than 1,000 feet AGL) to increase aircraft maneuverability.

If structural icing is expected or encountered during descent, sink rate should be increased until below the icing level to minimize exposure to this added risk.

A powerless pilot has yet another life-saving technique available. If there is absolutely no hope of rekindling the engine and if the aircraft is at a relatively high altitude, shut off the mags, adjust the mixture to idle cutoff, and reduce airspeed until the propeller slows to a halt. (This occurs near the stalling speed in most lightplanes.)

Stopping the prop is almost as effective on a single as feathering a propeller on a twin; total airframe drag is reduced substantially. If it is desirable to reach a distant airport, stopping the prop could make the difference, because this typically increases glide range by a whopping 20 percent (in most cases).

Or, if you are descending at the minimum-sink speed, such drag reduction decreases sink rate substantially. When I flew a Cessna 185 with a stilled prop, the aircraft floated earthward (and very quietly) at a modest 300 fpm. The sink rate in that airplane—which had a cargo pod—during a normal glide with the propeller windmilling was 900 fpm.

Short of stopping the prop, glide performance in some aircraft can be increased slightly by positioning the propeller in maximum pitch (low rpm).

One subject of controversy is the position of retractable landing gear during an off-airport, emergency landing. Unless specific conditions warrant otherwise, touch down on land with gear extended. This allows the gear legs to absorb some of the initial shock. A water landing should be made with wheels up.

Flap position also is a controversial subject. Generally, and shortly before touchdown, they should be extended. Remember, flaps hinder glide performance but reduce touchdown speed.

To minimize fire potential, fuel pumps, selector valves, and the master switch (if practical) should be turned off prior to touchdown.

It is interesting that some countries prohibit night and/or IFR flight in single-engine airplanes. Fortunately, the FAA imposes no such ban on U.S. pilots because night and IFR flying is a safe, rational activity—but only when tempered by conservative planning.

There can be risks, however. It is for each pilot to weigh the purpose of a specific flight against those risks to determine if and when the end justifies the means.

Chapter 36 **Precautionary Landings**

Every pilot has an ace up his sleeve—the precautionary landing. Simply stated, this is a premeditated landing, on or off an airport, when continued flight is possible but inadvisable.

Consider, for example, the low-flying VFR pilot who becomes engulfed in deteriorating weather while relatively far from an airport. He has a choice: continue into potentially worsening conditions (ahead or behind), or make an off-airport landing.

The second choice often is the safest. Yet the records show that a non-instrument-rated pilot caught in such a situation rarely exercises this option. Instead, he plunges onward, passing up one farmer's field after another until visual contact with the ground may be irretrievably lost. Eventually, he may collide with an immovable obstacle or lose control of the aircraft.

The National Transportation Safety Board, which has the task of investigating and tabulating general aviation's fatalities, states: "Any pilot who becomes trapped in weather and does not give serious thought to the feasibility of a precautionary landing (on or off an airport), frequently accepts the most dangerous alternative—continued flight."

Consider also the pilot running low on fuel. He thinks he has enough remaining to reach the nearest airport, but he isn't absolutely certain. Yet he often is willing to bet his life (and those of his passengers) on the unknown quantity of avgas sloshing in the tanks. This individual also has a choice: make a premeditated, off-airport landing with power or continue until a forced landing without power eliminates the option.

Such a pilot is a natural candidate for exercising discretion by opting for a precautionary landing. But will he? The statistics say no and indicate that a pilot is much more likely to risk fuel exhaustion than to make an off-airport landing while the engine is still developing power.

the passage of time, distance, and fuel eclipse the option. In short, he must be the captain of his fate, not the victim.

The primary objective of this discussion is not to recommend a precautionary landing under any specific set of circumstances. Rather, it is an attempt only to bring attention to a lifesaving procedure that is not implemented as often as it should be. Being aware of the alternative at least helps to simplify the decision, should it become necessary.

An objective discussion of this nature requires playing the devil's advocate. In other words, a precautionary landing might not be the best alternative. Perhaps there is enough fuel on board to hobble to the nearest airport. Perhaps the VFR pilot flying into worsening weather will find improving conditions on the other side of the pass. Perhaps continued flight would be the safest course of action.

Another reason not to land on the nearest highway is that we know from experience that a pilot usually is able to extricate himself from most difficulties. If every pilot who ever became nervous were to make a precautionary landing, there might be more planes than cars on some highways.

Also, a precautionary landing is not without hazard. Aircraft damage is not unlikely, and injury to those on board is certainly possible. A pilot who intentionally lands in a wheat field, totals the aircraft, and later finds that he did have enough fuel remaining to reach an airport, is going to be hard pressed for an explanation. But the action probably increased the probability of survival, and that's what the precautionary landing is all about. On the other hand, there might not have been sufficient fuel.

There are times, however, when a pilot should be willing to accept aircraft damage. It is far better to sacrifice the machine if this helps to protect the safety of those inside.

Some pilots feel that scratching or bending an airplane speaks poorly of his piloting skills. But if life is preserved in the process, the converse might be true.

So when is a precautionary landing advisable? Unfortunately, there is no cut-and-dried answer. It boils down to weighing the variables and exercising judgment. If a pilot begins to fear the outcome of continued flight because the risks are expected to increase beyond acceptability, he should consider a precautionary landing before it is too late.

Adverse weather and inadequate fuel reserves are not the only reasons that might warrant a precautionary landing. Other possibilities include:

- A visible oil leak of some magnitude.
- An indication of low oil pressure, excessive and uncorrectable cylinder-head or oil temperatures, or low fuel pressure. (An alarming indication by a single instrument usually is insufficient cause for emergency action unless an additional sign of abnormality confirms that something is amiss; the problem could be a faulty gauge.)
- Partial power loss.
- Any worsening engine difficulty (in single-engine airplanes).
- Serious airframe or powerplant vibrations.
- In-flight structural damage (bird strike, broken or cracked windshield, hail damage, strut failure, and so on).
- Impending nightfall when the pilot is untrained and the aircraft is inadequately equipped.
- Being hopelessly lost when help is unavailable and fuel reserves are low.
- A partially incapacitated pilot, especially when the condition is worsening.
- Any other situation likely to become more hazardous with continued flight.

Is it legal to make an off-airport, precautionary landing? Considering only the Federal Aviation Regulations (and not state, county, and municipal laws), no regulation prohibits landing on other than an airport. Additionally, a pilot-in-command has the emergency authority (and perhaps the obligation) to do whatever appears to be in the best interest of safety.

If a pilot opts to execute an off-airport, precautionary landing instead of risking an eventual forced landing (or worse), he shifts the odds of survival strongly in his favor. With the engine still running (or the visibility still reasonable), the pilot has time to gather his wits and select a suitable landing site—something that might not be possible later. He has time to drag the proposed landing area and reject it, should it appear undesirable. With power, he can land more slowly and with the precision needed to avoid the likelihood of an under- or overshoot. With power, he can always reject the landing and try again.

But once the fuel is exhausted or the ground becomes obscured, these advantages also disappear.

Although a planned, precautionary landing is almost always survivable, the same cannot be said about forced landings or untimely descents caused by other emergencies.

If a decision is made to land at other than an airport, a pilot should make the necessary preparations while time is still available.

The first step might be to attempt notifying someone of his intentions. This radio call should include aircraft identification and type, precise location of the landing site (if possible), and the number of souls on board. If communications cannot be established with someone on the ground, attempt to contact a nearby aircraft by making a call in the blind on a frequency you would expect to be monitored in that area.

Also, turn on the ELT while airborne (if possible), and set the transponder (if available) to the emergency code of 7700.

Next, prepare both aircraft and passengers. Securing the cockpit is the easy part: turn off unnecessary systems, reduce the electrical load as much as practicable, stow loose objects, and make sure a flashlight is kept handy (at night).

Calming the passengers and gaining their confidence might not be so easy. If time allows, explain the situation in unruffled tones. Don't give them cause for unnecessary alarm. If possible, keep them preoccupied

during the descent with such perfunctory chores as calling off altitudes every 500 feet or watching for traffic (even though the nearest aircraft may be 100 miles away).

Passengers also should be told how to protect their faces with pillows (or coats, blankets, and the like) during the touchdown and landing roll. Also review with them the operation of normal and emergency exits, if any.

If aircraft damage is considered possible, entertain the notion of opening a door or two prior to landing, but only if such action is known not to have an adverse, aerodynamic effect on tail surfaces. Otherwise, a twisted fuselage might make it impossible to open the door(s) on the ground. This is a particularly important consideration if the landing is to be made in water. A jammed door can prevent evacuation during the short time it takes to drown. Conversely, an open door reduces aircraft buoyancy.

Also consider having passengers remove dentures and eyeglasses.

However, if the landing is to be made on a paved, straight, miles-long highway cleared of traffic, much of this is unnecessary.

Ideally, the landing should be made on a level, smooth surface and into the wind. But try to select a site from which a subsequent takeoff can be made safely (with permission from the local constable, of course). Consider also that landing uphill considerably reduces landing roll distance, a rather convenient arrangement, especially if conditions later allow a downhill departure.

Unfortunately, there is not usually a wind sock available to determine wind direction, so use some savvy and look for telltale signs such as drifting smoke and dirt, or trees leaning with the wind. Or, look for a herd of cattle. These bovine beasts usually stand with their backsides into the breeze (or so I've been told). This presumably is an instinctive habit that allows them to see enemies approaching from ahead and smell those who approach from behind.

Once the landing site has been chosen and time permits, drag the field at least once to confirm that you've chosen wisely. Fly parallel to the "runway" at approach speed with the flaps partially extended. This allows for a relatively nose-low attitude and provides better visibility to search for potholes, ditches, wires, and other hazards that might not have been visible from a higher altitude.

When on a heading parallel to the direction of intended landing, set the heading indicator to 360 degrees. This is especially important if the approach is to be made during curtailed visibility, because it helps to standardize the "traffic" pattern and find the "runway" should the pilot become temporarily disoriented.

A book could be written to describe the techniques recommended to land on various types of terrain. Consequently, space permits only a few generalizations to be included here.

- When landing on a broad field of snow or in water, depth perception can be poor. Use a power-on descent to the point of touchdown.
- When ditching in a river, land downstream unless strong winds dictate otherwise. This reduces the relative touchdown speed between aircraft and water, thereby reducing damage potential.
- When landing on highways or roads, land with the traffic and be on the alert for wires and other man-made obstacles.
- If a tree landing must be made, attempt to allow both wings and the fuselage to contact the tree crowns simultaneously (and pray that the trees are not tall and widely spaced).
- In mountainous terrain (good luck), try to select an uphill slope. Avoid a situation where an excessively long landing roll would bring the aircraft to either a sharp dropoff or an area of severe lateral twist that might force the aircraft to perform a wingover into a canyon. When about to land on a steep upslope, maintain enough airspeed to convert the descent profile angle into a steep climb angle that closely matches that of the upslope gradient.

- In most cases, damage and injury are minimized by touching down as slowly and with as reduced a sink rate as is possible and practical.

Most of the time, however, pilots are not confronted with these extremes. Usually, it is a simple matter of finding a long field and landing parallel to the furrows. Or it might be as mundane as squatting on a dirt road in the desert.

But if the aircraft is damaged during the landing, be sure the fuel selector valve, master switch, and magnetos are turned off. (It is recommended that these items not be turned off prior to touchdown because this would eliminate the option of executing a last-minute go-around.) Then, with premeditated calm, evacuate the machine and lead the passengers safely away. Do not return until the probability of fire or an explosion is nil.

In the final analysis, there can be no precise determination as to the causes and circumstances that dictate executing a precautionary landing. In each case, a pilot must evaluate all factors on a balancing scale. If one side tips in favor of a precautionary landing, then, objectively and philosophically, he should exercise the option to land as soon as possible, airport or no.