With more general aviation pilots becoming instrument rated, there is a corresponding need for greater understanding of both utility and limitations of single-engine IFR operations

Mental Gauges For IFR 'GO-NO GO'

by DAN E. CHAUVET / AOPA 248200

■■ "Seattle Center, Skylane 8234 Sierra listening 120.3."

"This is Seattle Center."

"34 Sierra. I'm on top—my engine has just quit. I'm going down."

"No radar contact. What is your position?"

"Victor four—about 10 minutes west of Yakima VOR. I'm going down through a small hole in the undercast."

The pilot of the single-engine plane spiraled down through the small hole, broke out below the overcast over rugged mountains, and made a skillful landing on a narrow highway bordered by tall trees. The end of the wing was damaged hitting a highway sign. Later examination disclosed fuel exhaustion and a missing gas cap.

This episode closely resembles a recent actual occurrence when a pilot was flying on an IRF flight plan in a single-engine airplane. Fortunately, most single-engine IFR flights are routine and enjoyable, with no hair-raising experiences.

A quick look around the airports indicates that many pilots have not yet obtained the light twin airplane loaded with ADF, backup communications and navigation, DME and transponder. Single-engine airplanes far outnumber multi-engine aircraft and most have either the equipment that came in the plane when the owner bought it, or possibly the owner has made a few additions.

However, many single-engine airplane owners with limited equipment, lack of pitot heat and backup radio systems, still use their instrument ratings in various weather situations. Often they are avoiding layovers and saving considerable time on trips. More and more general aviation airplanes are flying on instrument plans these days and are increasing their utility significantly.

Discussing single-engine instrument flying with various pilots elicits a wide range of opinions. Some experienced pilots feel that no instrument flying should be done with single-engine planes. The principal reason seems to be that these pilots believe an engine failure would result in a descent through the clouds or obscuration with little chance of picking a suitable forced-landing spot.

Many other instrument rated pilots believe that engine failure is a rather remote possibility. "Reliability of engines nowadays, and the usual maintenance, make the odds of engine failure very slim," one of these said. "With one engine you have half the engine problems you have with two fans. If I thought the engine was going to stop, I wouldn't fly VFR either."

A middle of the road opinion is most often heard: "Whether I take off on instruments depends on several things. One power failure is too many."

Opponents of single-engine instrument flying also base their arguments on the possibility of a generator or electrical system failure during IFR conditions, which would leave the pilot with no communications or navigation information.

Most IFR pilots have established some criteria for deciding whether or not to fly. They have categorized the weather and have in mind a number of situations they consider "go" or "no go." In use, these "categorized" weather situations are compared with actual weather and the decision is simplified. In the development of these standards, weather is only one of several interrelated considerations.

A pilot's own personal experience, currency and proficiency are factors in decision making. A pilot who files IFR regularly, getting in hood time, or doing actual instrument flying, will have more confidence in his ability to handle a wide range of IFR situations. The pilot who is barely current will not be as confident and may decide to wait for weather improvement. The wise and safety-conscious pilot will assess his own ability and the specific situation. If the pilot is current and proficient, the airplane and its equipment will be the next decision-influencing factor.

The airplane—its performance, radio equipment and other accessories—is a major criterion for deciding to go or not to go. A plane that has a cruising speed of 100 knots and a maximum sea level rate of climb of 600 f.p.m., which has one combination communication—navigation radio—and lacks pitot heat will be of more limited use than one superior performance, dual nav/com equipment, ADF, DME, glide slope and marker beacons, pitot and gas vent heat, alternate static source, and possibly prop anti-icers.

Radio equipment in single-engine aircraft varies more than in multi-engine planes. Some airplanes are equipped with venturi and venturi-driven instruments, subject to failure from ice accumulation.

Terrain along and adjacent to the proposed route is a major factor in planning for single-engine instrument flight. The capable instrument pilot knows his approximate position at all times during the trip, whether he has DME or not. An important part of planning is to know the best direction to go in the event of engine failure at any position along the route.

Use of a WAC or sectional chart in flight planning is desirable if the pilot is not familiar with the terrain. Terrain itself might be a factor that would make the prudent pilot decide against a flight. Mountainous or remote forest-covered regions are dangerous forced-landing areas. However, a combination of terrain and weather might make the flight relatively safe, such as a high ceiling above flat terrain.

Single-engine IFR flying over mountainous regions of the West and IFR in the comparatively level Eastern regions of the United States are two entirely different situations.

Radar service availability would be worth considering in preflight planning. If the engine failed, could vectors be obtained to a nearby airport or area where a successful forced landing would be possible?

During the weather briefing the pilot will probably compare the situation and possible flight conditions with a number of categories of weather situations that he has in mind. Relating the factors of proficiency, equipment and terrain, he decides which weather situation would be favorable and if the current weather is acceptable for flying.

Well-developed cold fronts, occluded fronts, warm fronts with icing at various levels, significant turbulence, possible thunderstorms, and high winds would be allowed to pass through before most single-engine pilots would fly. After frontal passage, stratus clouds sometimes persist for extended periods.

The following five weather examples illustrate how an IFR pilot might arrive at his "go—no go" decision:

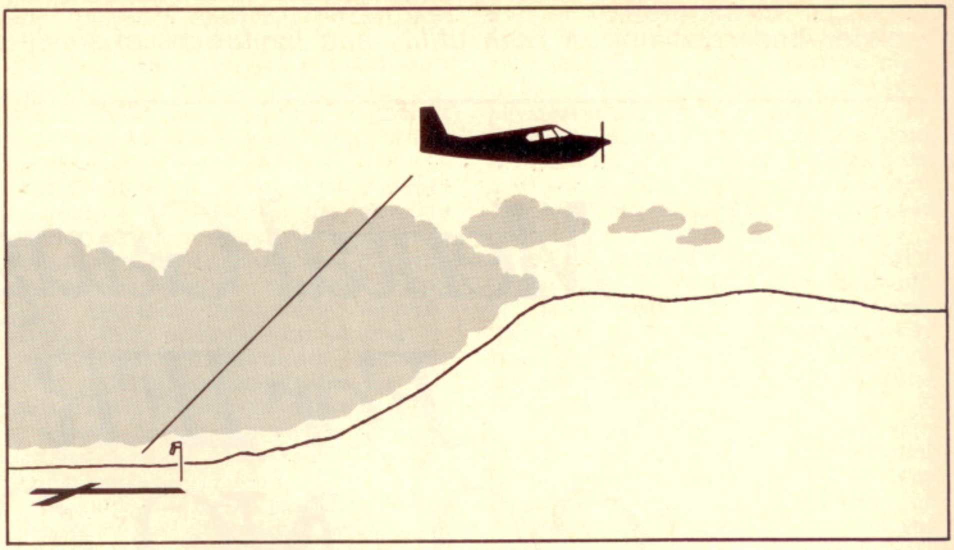
Local stratus or fog and smoke conditions that persist for lengthy periods prevent VFR operations. For instance, stratus 200 to 2,000 feet thick lies on the surface, making visibility one mile or less (see Figure 1). Most instrument rated pilots will depart and be on top or even away from the obscured area in a few minutes.

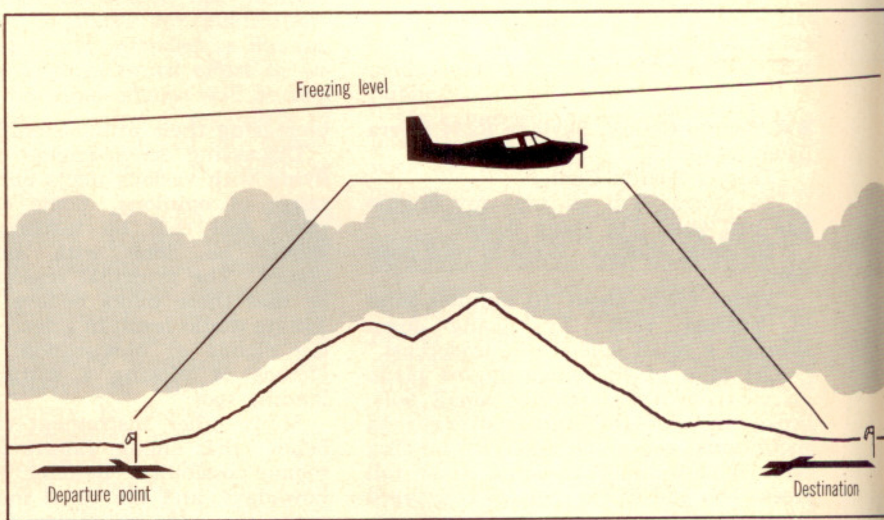
The writer has made several such departures which required only communications, as runway heading was maintained until the plane was VFR on top. A departure from an airport along the Pacific Coast was made when weather was ceiling 200 feet obscured, visibility about three-quarters of a mile in fog and smoke. Tops were 1,000 feet above the airport. Visibility on top was unlimited and the remainder of the trip was excellent VFR. The airplane, a Cessna 172, was equipped with a single radio. No other IFR equipment was available or needed.

True, engine failure shortly after takeoff would have resulted in a descent on instruments. Familiarization with local terrain near the airport, therefore, might result in less damage. Many pilots flying under these conditions will select or request a certain runway that has the least obstructions off the end of it.

On the other hand, many pilots request special VFR clearances out of control zones which may result in low flying and often more hazardous operations than IFR departures. Violations of FAR 91.79 dealing with minimum clearance from structures and towns are

FIGURE 1. *Conditions requiring IFR takeoff, VFR on top en route are fairly common and discourage few instrument pilots from departing as scheduled.*





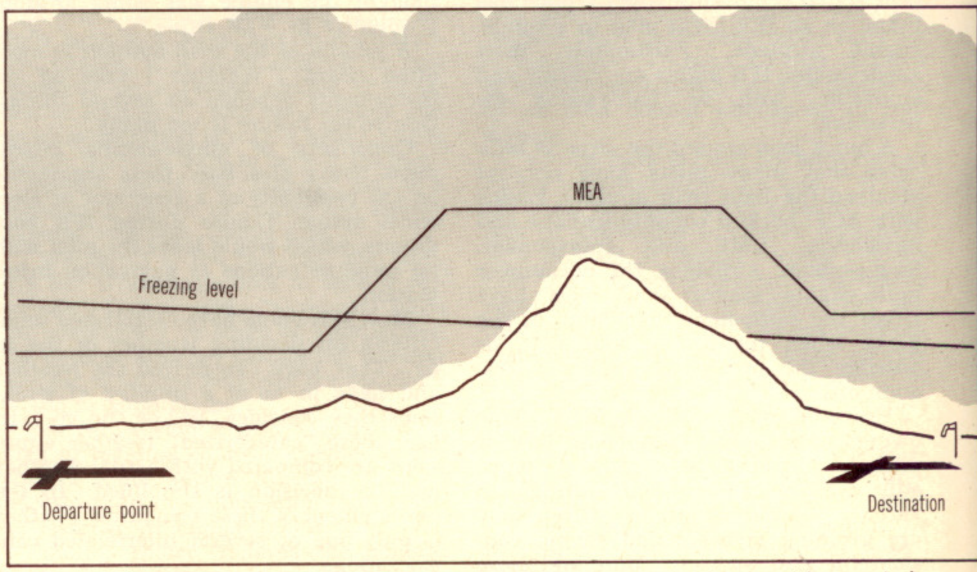


FIGURE 5. *Flying actual instruments above the freezing level is too risky ever to be done in a single-engine plane, most experts agree.*

possible in special VFR clearances.

Departure through freezing fog or stratus requires more consideration. Exposure time to icing conditions, pitot heat, and severity of icing are factors that have to be evaluated. Often a little rime or no ice is picked up, even though temperatures are below freezing. Before takeoff it is well to spray an ice preventative on all leading edges and propeller for temporary anti-icing.

Almost all pilots will consider the departure to VFR conditions on top to get out of locally obscured areas. Most feel that carburetor ice is no particular problem because of the use of climb power.

The reverse weather condition, where the terminal area is below VFR minimums, is not uncommon in many areas of the country. Again, the consensus of single-engine instrument pilots is that they would make the transition and approach. Exposure to actual instrument operations may be low and this certainly would influence the pilot's decision.

Radar service availability increases the chances of a successful forced landing in the event of power failure if the aircraft is not at a low transition altitude. Even then, radar vectors might be of help in reaching an airport or more favorable landing area. The argument that the organized transition and approach is safer than sneaking in low on special VFR has merit.

On the subject of engine failure, a VFR pilot may speak for many when he says, "At least you can see where you are going to go down, even though there may not be very many choices." IFR into a terminal area would seem to be a safer operation than the departure because altitude has already been obtained.

Radio navigation equipment required depends on the approach and transition. Although inadvisable, a person could make a surveillance on PAR approach with only communications. A "one-and-a-half" system would be the least required for the VOR and ILS with radar. The transition and ILS to minimums might require ADF, localizer, glide slope, and marker beacons. Lack of equipment could preclude an approach at the destination.

The third hypothetical but common situation is one in which an extensive stratus or stratocumulus layer covers the departure point, en route segment and terminal area. The freezing level is above the proposed en route altitude, with VFR conditions on top. Departure and terminal areas are above VFR minimums, but part of the enroute segment is IFR. The aircraft is not transponder equipped, but has two navigation receivers and a communications transceiver. Backup navigation and communications equipment is important in this situation. Much of the en route terrain is not flat, but hilly and forested.

Many IFR single-engine operations involve a climb to VFR on top, flight en route on top and an instrument approach to landing. Providing there is

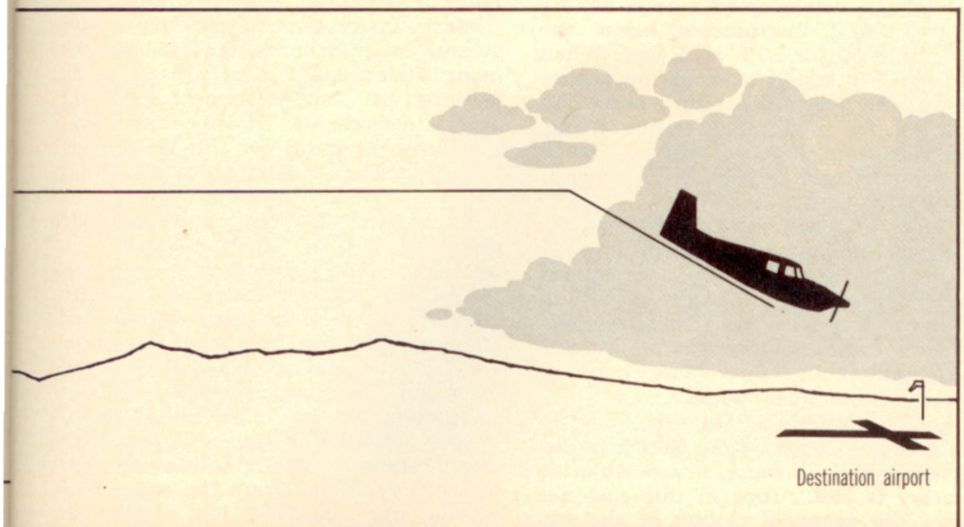
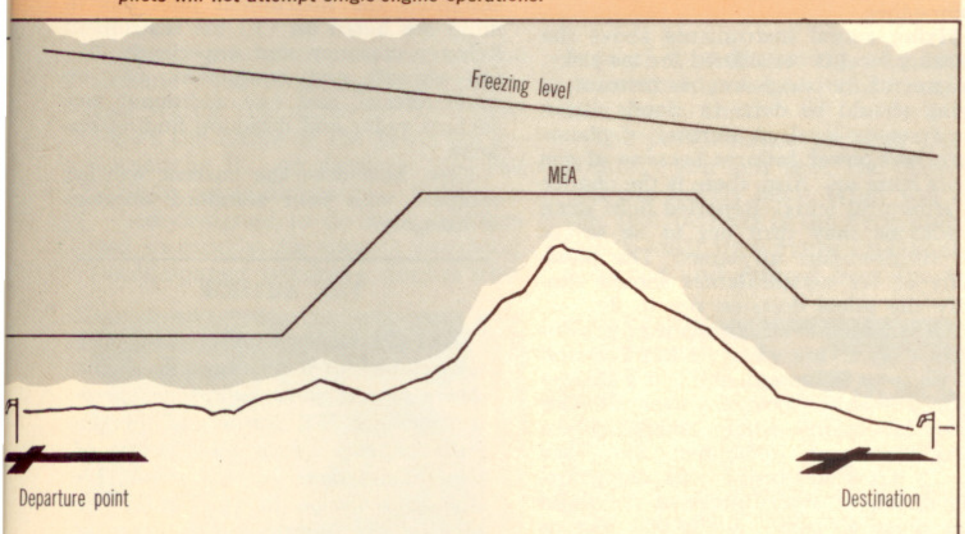


FIGURE 2. *With terminal area reported obscured, no icing and en route conditions VFR, and only transition and approach to be conducted IFR, single-engine operation is regarded as safe as multi-engine.*

◄ **FIGURE 3.** *Obscuration of departure, en route and terminal areas, coupled with some icing conditions is a situation in which the single-engine IFR pilot should weigh all factors carefully.*

FIGURE 4. *Flight on solid instruments, even though freezing level remains above minimum en route altitude, is a condition in which most seasoned instrument pilots will not attempt single-engine operations.*



no equipment malfunction, there is no problem and the whole operation seems simple and routine. While many single-engine operations do occur in similar situations, there are many pilots who will not fly with this amount of exposure.

One experienced instrument pilot and instrument instructor said he is willing to fly actual instruments below the freezing level for 25% of a trip. When half the trip would be made on instruments with little or no ceiling below, he will not fly in a single-engine plane. Exposure time to actual instruments or on top is a primary factor in his decision to fly or not fly.

Those who will not fly on top probably will not fly at night over sparsely settled areas, unfamiliar or mountainous terrain. Engine failure would result in a forced landing in an unsuitable area. Loss of radio might result in serious navigation problems, possibly requiring radar vectors or DF steers.

Another weather situation beneath the freezing level would be where departure point, en route, and destination weather is IFR. Tops in this case are above the practical ceiling of the aircraft, but the freezing level is well above the minimum en route altitude. The proposed flight would be made on solid instruments.

Most experienced instrument pilots do not recommend single-engine flying in the above situation because of the remote chance of equipment failure. Chances of engine failure are slightly higher in actual instrument conditions because of the increased possibility of carburetor or induction ice, and moisture getting into electrical parts.

If such a flight is made, radio equipment should include two communication and navigation systems, marker beacon, and possibly ADF for transitions and approaches.

Flying actual instruments above the freezing level is considered far too risky. In general, no single-engine instrument flying should be done in clouds above the freezing level. A number of planes have had power failures because of gas vents icing up. Also, there is the chance of structural icing. Reported light icing conditions may turn out to be severe for single-engine airplanes. The possibility of ice accumulation should simplify the pilots decision not to fly.

An experienced instrument pilot learned by trying when he left Portland en route to Redmond, Ore., in a Cessna 206. The route took him over the Cascade Mountains where much of the terrain is over 7,000 feet above sea level. After an instrument departure, the initial en route phase of the flight was clear of clouds at 14,000 feet as was anticipated.

"As I came to the mountains, I was in and out of the stuff," he said. "Then I was solid. The gas vents froze and the engine quit. I headed down in a direction that I figured would take me away from the highest terrain. I broke out in a small valley at about 5,500 feet and below the freezing level. Happily, the engine restarted. No more solid instruments with single-engine for me."

A pilot's experiences with engine failure are probably an important factor in his decision to fly or not. One pilot claimed he had five engine failures in his first five hours of flying. Others with hundreds of hours have never experienced power failure.

Most instrument flight instructors believe it is essential that the instrument student, in the later part of his training, get some experience in flying actual instruments. The weather situation most favorable for this training is a high ceiling with freezing level well above the minimum en route altitude. Adjacent VFR conditions also are desirable as an alternative if the weather should come down.

The instructor usually has definite standard weather situations in mind for training. He considers these weather conditions comparatively safe for the operation. By comparison, instrument instruction to an experienced multi-engine pilot in a well-equipped twin would allow use of a lower standard weather situation. Here the equipment affects the decision on minimum weather conditions for training.

A multi-engine airplane with prop anti-icers, boots, alternate static, pitot and gas vent heat, and oxygen can operate in a wider range of IFR conditions but still is limited. Moderate to heavy icing, moderate or worse turbulence, and thunderstorms are serious conditions for multi-engine aircraft. Weather standards vary as equipment varies.

There are so many variables other than weather conditions alone that no fast and firm rules can be written out, especially for single-engine aircraft that vary so much in performance and equipment. To review, standard weather situations the instrument pilot has in mind are based on (1) his instrument flying proficiency and experience, (2) the aircraft and equipment, (3) en route terrain, and (4) additional aids such as radar and direction finding stations.

Now, how does the current weather compare with your standard situation or category? □

THE AUTHOR

Dan Chauvet is a professional pilot who claims, as a driving interest, the desire to see more lightplane operators achieve IFR status and thereby enhance the safety and utility of general aviation. In this article, his first contribution to The PILOT, he tackles the controversial issue of single-engine IFR flight and under what conditions the experienced instrument pilot will attempt it. He is a flight and instrument instructor, ASMEL, and is employed as a charter pilot and instructor for Bradley Aviation, Boise, Ida.
