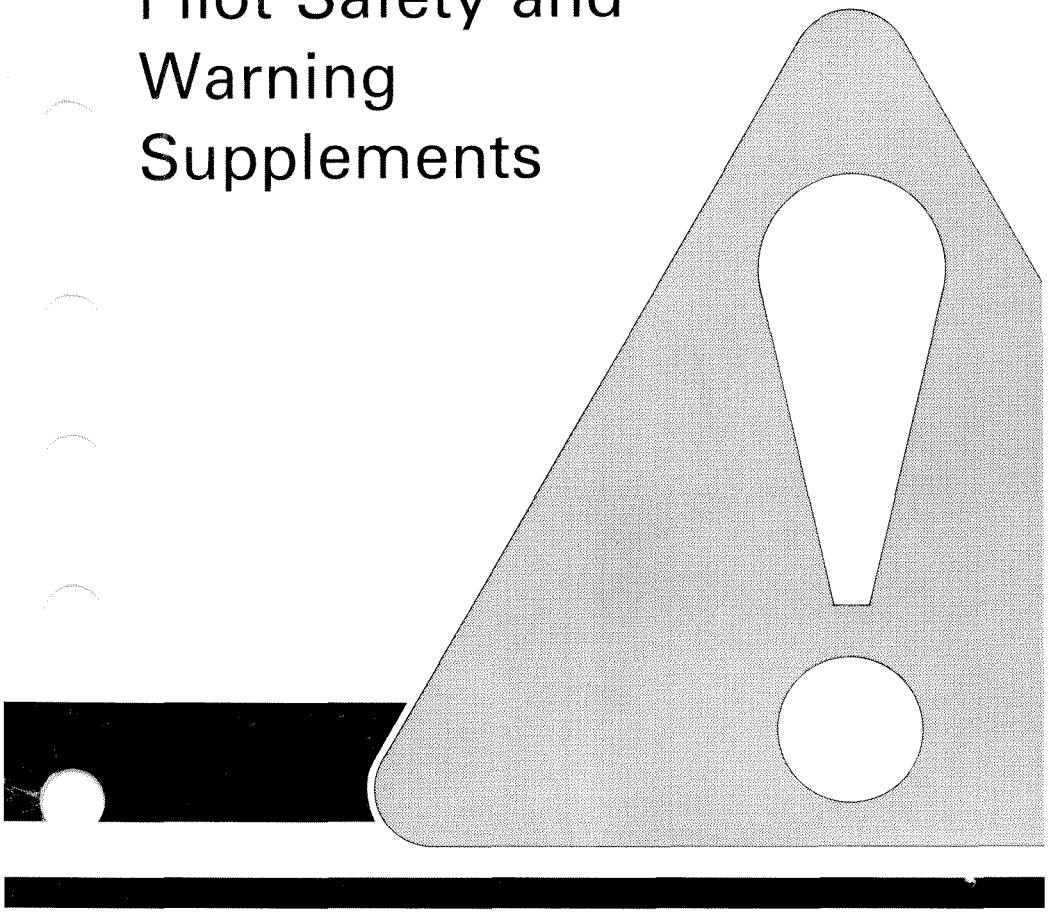
Cessna

Pilot Safety and Warning Supplements



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⚠ SINGLE-ENGINE FLIGHT INFORMATION (MULTI-ENGINE AIRPLANES)

INTRODUCTION

The following discussion is directed, primarily, at the pilots of propeller-driven, light twin-engine airplanes, powered by reciprocating engines and certified under Part 23 (CAR Part 3 for older models) of the Federal Aviation Regulations. It is not intended to apply to specific models, but is intended, instead, to give general guidelines or recommendations for operations in the event of an engine failure during a flight.

SINGLE-ENGINE TAKEOFF AND CLIMB

Each time a pilot considers a takeoff in a twin-engine airplane, a major concern should be to understand and remember the Minimum Control Speed (VMC) for that particular airplane. Knowledge of this speed, is essential to ensure a safe recovery of the airplane in the event an engine loss occurs during the most critical phases of flight: the takeoff and initial climb.

VMC is the minimum flight speed at which the airplane is directionally and laterally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling, not more than a 5-degree bank toward the operative engine, takeoff power on operative engine, landing gear retracted, flaps in takeoff position, and the most critical C.G. (center of gravity). A multi-engine airplane must reach the minimum control speed before full control deflections can counteract the adverse rolling and/or yawing tendencies associated with one engine inoperative and full power operation on the other engine. The most critical time for an engine failure is during a two- or three-second period, late in the takeoff, while the airplane is accelerating to a safe speed.

Should an engine failure be experienced before liftoff speed is reached, the takeoff **must** be aborted. In addition, if an engine failure occurs immediately after liftoff, but before the landing gear is retracted, the takeoff

should also almost always, be aborted since airplane performance with an engine out at this time will be well below optimum, and continued flight may be improbable.

The pilot of a twin-engine airplane must exercise good judgment and take prompt action in the decision whether or not to abort a takeoff attempt following an engine failure, since many factors will influence the decision. Some of these factors include: runway length, grade and surface condition (i.e., slippery, dry, etc.), field elevation, temperature, wind speed and direction, terrain or obstructions in the vicinity of the runway, airplane weight and single engine climb capability under the prevailing conditions, among others. Obviously, the prudent pilot should abort the takeoff, following an engine-out, even if the airplane has lifted off the runway, if runway conditions permit. However, under other circumstances (i.e., short runway with obstructions) the same pilot and airplane would have to continue the takeoff following a liftoff and an engine-out. In any case, the emergency procedures appropriate to the situation must be executed by the pilot.

While it may be possible to continue the takeoff at light weights and with favorable atmospheric conditions following an engine failure just after liftoff, long distances are required to clear even small obstacles. The distances to clear an obstacle are reduced under more favorable combinations of weight, headwind component, or obstacle height. However, any mismanagement of single-engine procedures would more than offset the slight advantage offered by continuing the takeoff.

The pilot's decision to continue the takeoff after an engine failure should be based on consideration of either the one-engine inoperative best angle-of-climb speed (V_{XSE}), if an obstacle is ahead, or the one-engine inoperative best rate-of-climb speed (V_{YSE}), when no obstacles are present in the climb area. Remember that once the one-engine inoperative best angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. On the other hand, the one-engine inoperative best rate-of-climb speed becomes important when there are no obstacles ahead, or when it is difficult to maintain or gain altitude in single-engine emergencies. Always refer to the Owners Manual, Flight Manual or Pilot's Operating Handbook for the proper airspeeds to be used in the event of an engine failure during takeoff and the pilot elects to continue the takeoff attempt.

Should an engine failure occur at or above these prescribed airspeeds, the airplane, within the limitations of its single-engine climb performance, may be maneuvered to a landing back at the departure airport. After the airplane has been cleaned up following an engine failure (landing gear and wing flaps retracted and the inoperative propeller **feathered**), it may be slowly accelerated to its single-engine best rate-of-climb speed. If im-

mediate obstructions so dictate, the single-engine best angle-of-climb speed may be maintained until the obstacles are cleared. In no case should the speed be allowed to drop below single-engine best angle-of-climb speed unless an immediate landing is planned since airplane performance capabilities will fall rapidly as the airspeed decreases. After clearing all immediate obstacles, the airplane should be accelerated slowly to its single-engine best rate-of-climb speed and the climb continued to a safe altitude which will allow maneuvering for a return to the airport for landing.

To obtain single-engine best climb performance with one engine inoperative, the airplane must be flown in a 3- to 5-degree bank toward the operating engine. The rudder is used to maintain straight flight -- compensating for the asymmetrical engine power. The ball of the turn-and-bank indicator should not be centered, but should be displaced about 1/2 ball width towards the operating engine.

The propeller on the inoperative engine **must be feathered**, the landing gear retracted, and the wing flaps retracted for continued safe flight. Climb performance of an airplane with a propeller windmilling is severely degraded. Once the decision to feather a propeller has been made, the pilot should ensure that the propeller feathers properly and remains feathered. The landing gear and wing flaps also cause a severe reduction in climb performance and both should be retracted as soon as possible (in accordance with the operating handbook limitations).

The following general facts should be used as a guide if an engine failure occurs during or immediately after takeoff:

1. **Discontinuing a takeoff upon encountering an engine failure is advisable under most circumstances. Continuing the takeoff, if an engine failure occurs prior to reaching single-engine best angle-of-climb speed and landing gear retraction, is not advisable.**
2. Altitude is more valuable to safety immediately after takeoff than is airspeed in excess of the single-engine best angle-of-climb speed.
3. A windmilling propeller and extended landing gear cause a severe drag penalty and, therefore, **climb or continued level flight is improbable**, depending on weight, altitude and temperature. Prompt retraction of the landing gear, identification of the inoperative engine, and feathering of the propeller is of utmost importance if the takeoff is to be continued.
4. Unless touchdown is imminent, in no case should airspeed be allowed to fall below single-engine best angle-of-climb speed even though altitude is lost, since any lesser speed will result in significantly reduced climb performance.
5. If the requirement for an immediate climb is not present, allow the airplane to accelerate to the single-engine best rate-of-climb speed

since this speed will always provide the best chance of climb or least altitude loss.

SINGLE-ENGINE CRUISE

Usually, losing one engine during cruise on a multi-engine airplane causes little problem for a proficient, properly trained pilot. After advancing power on the operating engine and retrimming the airplane to maintain altitude, if possible, the pilot should attempt to determine if the cause of the engine failure can be corrected in flight prior to feathering the propeller. A quick check of the magneto/ignition switches should be made to see if they are on, and a check of the fuel flow and fuel quantity for the affected engine should also be made. If the engine failure was apparently caused by fuel starvation, switching to another fuel tank and/or turning on the auxiliary fuel pump (if equipped) or adjusting the mixture control may alleviate the problem. It must be emphasized that these procedures are not designed to supplant the procedural steps listed in the emergency procedures section of the airplane operating handbook, but are presented as a guide to be used by the pilot if, in his judgment, corrective action should be attempted prior to shutting down a failing or malfunctioning engine. Altitude, terrain, weather conditions, weight, and accessibility of suitable landing areas must all be considered before attempting any trouble shooting procedure. In any event, if an engine fails in cruise and cannot be restarted, a landing at the nearest suitable airport is recommended.

SINGLE-ENGINE APPROACH AND LANDING OR GO-AROUND

An approach and landing with one engine inoperative on a multi-engine airplane can easily be completed by a proficient, properly trained pilot. However, the pilot must plan and prepare the airplane much earlier than normal to ensure success. While preparing, fuel should be scheduled so that an adequate amount is available for use by the operative engine. All crossfeeding should be completed during level flight above a minimum altitude of 1000 feet AGL if required to maintain lateral balance within published limits.

During final approach, the pilot should maintain the one-engine best rate-of-climb speed or higher, until the landing is assured. An attempt should be made to keep the approach **as normal as possible,** considering the situation. Landing gear should be extended on downwind leg or over the final approach fix, as applicable. Flaps should be used to control the

descent through the approach. Landing assured, means that the airplane is in a position from which a normal approach to the runway of intended landing can be made, and the approach threshold of that runway, or the approach lights or other markings, identifiable with the approach end of that runway, are clearly visible to the pilot.

Consideration should be given to the worst conditions possible --- a loss of the other engine or the necessity to make an engine inoperative go-around. Under certain combinations of weight, temperature and altitude, level flight may not be possible if an engine inoperative go-around is attempted. In any event, **do not** attempt an engine inoperative go-around after the wing flaps have been extended beyond the normal approach or the published approach flap setting, unless enough altitude is available to allow the wing flaps to be retracted to the normal approach or the published approach flap setting, or less.