Multi-Engine Airplane Survival

Most light twins will perform as advertised—the others will do better—if they have good engines, but a lot depends upon the pilot's understanding the power he has available and how to use it

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■■ Congratulations. You have just purchased a modern, efficient light-twin airplane. You are, if an average pilot, approximately half as safe as you were in your previous single-engine flying machine.

There are several reasons for you to be properly cautious about your new airplane. Not that it is in itself unreliable or unairworthy—far from it. The crux of the problem is you, however, and your reliability and understanding of the key parameters of multi-engine operation. You must constantly realize, understand, and be competent to cope with the limitations of the man as well as the machine. Failure to do this will assuredly be hazardous and expensive.

Most problems light airplane pilots have after transitioning to twins stem from training or, more precisely, from lack of it. The salesman or instructor—with some notable exceptions—usually is trying to get you "checked out" or get you "rated," rather than give you the expensive precision practice and training really required. Also, the aircraft salesman is naturally interested in selling you on the good points of the airplane, rather than pointing up its less sterling qualities. It follows, then, that if you are at all unsure of the quality of your rating training or checkout, you should seek the advice and help required from a competent, experienced multi-engine instructor. By multi-engine instructor, I refer to one who has much experience in multi-engine *training*, not an instructor with a lot of single-engine time who happens to have a little-used multi-engine rating.

Most light-twin aircraft will perform as advertised with good engines; the remainder will perform slightly better. That is, they will maintain the specified rates of climb or altitudes with an engine out, assuming the specified criteria are met. These include gross weight, density altitude, engine condition, accurate airspeed control, and smooth, precise control manipulation. The most critical requirement remains so for all time: airspeed.

Two quick definitions are in order at this time: those of Vyse and Vxse.

Vyse is "best-rate-of-climb airspeed, single-engine." It is also the airspeed at which the airplane is able to maintain level flight with the least power and gain the most altitude per unit of time with an inoperative engine.

Vxse is "best-angle-of-climb airspeed, single-engine." It is the airspeed at which the airplane will gain the most altitude for forward distance traveled, again with an engine inoperative. This speed is only of interest for obstruction clearance and is not a speed to be maintained longer than necessary.

The airplane will not climb as fast at Vxse, and it requires more power per foot of altitude gained than Vyse. Therefore if you cannot maintain at least level flight at Vyse, you darn sure cannot at Vxse. Conversely, if you can maintain at least level flight at Vxse, you normally can reach and climb at Vyse. To summarize: should conditions occur which preclude attaining Vyse, *or* if the airplane is still descending at Vyse, then *you are only able to control the direction of the ensuing crash,* and it is imperative that you know it and plan for it.

I know of no twin-engine, normally aspirated, propeller-driven airplane which will maintain altitude above 3,000 feet m.s.l. with a *windmilling*, inoperative engine. While this statement assumes gross-weight conditions, other problems, such as high density altitude, make it equally true for less-than-gross-weight operation.

Your reaction may be: "But that's a windmilling engine and my bird has full-feathering props . . ." So what? Feathering on some twins requires significant electrical power which might not be available. Others require engine oil pressure for feathering, and considerable initial r.p.m. Do you know how yours works?

Should you lose oil pressure all may not be irretrievably lost, as the engine may sieze. This is good! A stopped flat-pitch prop has considerably less drag than one which is windmilling, so if you cannot feather one, try and stop it. Assuming you cannot do either, you are in deep yogurt, and a descent is inevitable.

Let's talk momentarily about "minimum control speed," alias Vmc. It is a figure computed under the most unfavorable conditions obtainable and only references *directional control*, not climb or descent performance. The parameters used to derive it include retracted landing gear, full takeoff power on the noncritical engine, takeoff flap setting, center of gravity at the aft limit, and the critical engine windmilling.

Any alteration of these criteria will lower VMC. If the airplane is under gross weight, or the gear or flaps are extended, or the dead engine is feathered, or the good engine is not strong, or the dead engine is not the critical engine, VMC will be lower than specified. Isn't that comforting? Well, no, it's not. If you cannot accelerate to at least VYSE or VXSE and climb, you are still going to lose altitude, and hanging on at VMC when all is inevitable may allow the crash to occur off the airport instead of on it. We are only interested in VMC for directional control, and then only for directional control on the runway; we should be above VMC prior to takeoff.

We get attached to VMC during our airborne instruction. We learn the loss of directional control somewhere near VMC (on the low side) when practicing single-engine slow flight. Single-engine slow-flight practice may well be akin to practicing bleeding. We kill more people in this practice than we do from actual engine failures.

With the foregoing as preamble, let's discuss normal operations and how to fly them. Following that will be a few paragraphs on abnormal situations, or "what to do until the airplane quits moving."

Make a proper preflight, both internal and external. This should include a proper functional check of all generators and hydraulic pumps, as applicable. It should also include sampling fuel from all tanks.

If all tanks are full, start on the mains or tips, taxi on the auxes, and run up on the mains. Alter this for partial fuel loads as required; be sure you do the runup on the tanks used for takeoff. After the runup is complete, verify trim settings, controls unlocked and free to all stops, fuel selectors on proper tanks and in their detents, and the doors closed and locked.

Apply takeoff power smoothly and slowly. Five seconds from idle to takeoff power will lengthen the run slightly, but it is easier on the machinery. Use full takeoff power on every takeoff. While the engines may accelerate satisfactorily with climb power, the engines may not be adequately cooled due to lack of power enrichment operation.

After takeoff power is reached, lock all power controls with the palm of your hand. Hold the airplane on the runway until VMC has been passed. The airplane may want to fly prior to VMC; do not allow it. After VMC, let the airplane fly when ready, but remain in ground effect until reaching best-rate-of-climb speed (VY). Climb at VY until reaching 500 feet above ground level (a.g.l.). Do not retract the gear until there is no possible way you could land on the remaining runway and overrun. After 500 feet a.g.l. is passed, and the gear and flaps are up, slowly make the reduction to climb power. Adjust cowl flaps and then, and only then, attain en route climb speed. Clean up the after-takeoff check list and then you may enjoy the ride.

Now what have you done? Let's take each step in order:

1. You thoroughly checked electrical and hydraulic systems to verify continued systems operation as far as possible after loss of an engine.

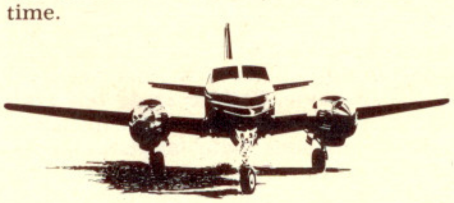
2. You precluded inadvertent power loss due to contaminated fuel or trying to fly on the "off" tank, in which there is no fuel.

3. You insured against partial power loss due to creeping power controls until safely airborne and at a reasonable altitude.

4. You insured your ability to land on wheels instead of propellers in the event of power loss during and immediately following takeoff.

5. You insured that the airplane gains the most altitude in relation to time before making the first—historically most critical—power reduction.

6. You have covered—or tried to—as many problem areas as possible during takeoff, and have done it with minimum possible wear on the equipment. Further, you have progressed through the takeoff in the minimum practical time.



A minimum-run takeoff or other high-performance problem only changes those portions of the preceding concerning initial run, liftoff, and initial climb. Set full power before brake release. Rotate and climb at VX instead of VY. If your airplane has gear doors which are normally open on the ground, or no doors, retract the gear when safely airborne. If the doors are normally closed except during gear transit, leave the gear down. The gaping holes uncovered by the opening doors will cause considerably more drag than the down-and-locked gear itself. When clear of the limiting obstruction, allow the airspeed to increase to VY, retract the gear and continue as before.

A word or two on normal landings may be in order. VMC is a nice-to-know number, but we are only concerned with it on takeoff and in takeoff configuration. VMC with landing configuration and approach power is below "landing-configuration stall speed," Vso. The landing should be based upon a final approach speed of 1.3 Vso plus one-half the gust velocity. Therefore, if Vso for the present gross weight is 70 knots and the wind is down the runway at 10 knots, with gusts to 20 knots, the proper final approach airspeed would be: 1.3 Vso = 91 knots plus one-half of 10 knots, or 96 knots. A minimum-run situation might require 1.15 Vso and all the gust factor. In the above example, the minimum-run landing final approach speed would be: 1.15 Vso = 80 knots, plus 10 knots, or 90 knots.

As the landing is assured—over the fence—allow the airspeed to dissipate commensurate with runway length. Should you have to make a *multi-engine* go-around, apply takeoff power if required, and bring the flaps up to takeoff position. After the airplane is up and climbing, raise the gear and continue as in a normal takeoff.

Now we start with the problems. If you lose an engine prior to liftoff, *abort!* All throttles idle, and get on the brakes, hard. Brakes and tires are cheaper than nose struts and props, so get it stopped on the runway. Engine failure after liftoff requires the same action if sufficient runway remains.

The next is the bad one. You lose an engine after becoming airborne; you're out of runway, and you cannot attain at least VXSE for some reason. *Make your decision where you want it to crash and keep flying it until it gets there and does, because it's going to.*

Now the easy one. You lose an engine around 600 feet a.g.l., while retarding the engines to climb power. First and foremost: identify the *good* engine. You have no control over the dead one, so make sure you know which is the good one. It is the one on the same side as your foot which is doing the work. It has the higher cylinder-head temperature of the two, and it is not decreasing. Do not rely on manifold pressure, r.p.m., or fuel flow as indicators, as they may tend to remain the same as the other engine.

With the good engine identified, the other one must be the dead one. Grasp its throttle and bring it to idle. If nothing changes, you have indeed the dead engine's throttle. Grab its propeller control and feather the windmilling prop. Move the feathering control rapidly and positively into the feathering detent. If you have properly balanced the drag of the windmilling prop, the nose of the airplane will now yaw towards the good engine. This is an adequate indication of feathering for the moment, especially at night when you are a bit busy to look.

Maintain VYSE or use VXSE if required. If everything works as advertised, the airplane will climb. Climb this way until a thousand feet or so above the airport and cautiously retard the good engine to "maximum except takeoff" (METO), or to climb power if these lower settings will allow you to maintain altitude and accelerate above VYSE.

If you are going to return to the departure airport and land, you are in good shape. Turn downwind and *fly the exact same pattern you always do.* This is no time to become a test pilot and start experimenting with a new pattern whose key points are not visually familiar.

If you have sufficient power reserve, extend the gear on downwind so you will have time to get it down manually if necessary. If no margin of power exists, leave the gear up until starting the descent on base leg.

Lower the flaps to the takeoff position —or to half, if no takeoff position is specified for your machine—early on the base leg and stabilize the airspeed.

On final, set full flaps when landing is assured, and maintain precise, *normal* airspeed for a normal landing. This is important, as the airplane will float farther with a feathered propeller than with two engines in idle.

Do not get suckered into a go-around with an inoperative engine *unless you can start it at least 500 feet a.g.l.* If an airplane, car, or cow blocks the runway, land beside it, over it, on the taxiway, or on the grass, but do not go around after you are committed on final approach. Your chances of losing control on a balked landing approach with an engine out are excellent. I would much rather land long and take out the gear and props than foul up a single-engine go-around and take out the entire airplane.

If you lose an engine and are not going back to the departure airport, or if you are, but it will require a long instrument operation, you should clear up the details when time, altitude, and navigation chores permit.

First, climb to the altitude you require at VYSE. After level-off, you may be able to maintain VYSE or higher at 75% power on the good engine. If not, take the power required, as you can always change that engine too. Do not forget to monitor fuel consumption, as it will be high. Cross-feed as required; be sure of desired fuel-panel setup prior to switching tanks.

At this point evaluate the cause of power loss. If it was fuel starvation and you have available fuel, you may consider a restart attempt. Control may become marginal during restart attempts made at night or in weather.

If you have decided not to restart, or the attempt failed, finish the cleanup when time permits. Turn off the fuel to the dead engine and close its mixture and cowl flaps. Turn off the magneto switch caution; listen for a change in sound as you switch through the "left" and "right" positions. You might just have grabbed the wrong switch.

If you have additional time and leisure, dig out the book and refresh yourself on emergency systems operation and reevaluate all that you have lost. The descent and landing are the same as normal unless the manufacturer says otherwise. If the approach will be on instruments, do not lower the gear until you are on final approach inbound. If you cannot get the flaps down, continue with normal airspeeds for a normal no-flap landing; again, no "cushion."

Do not forget to retard power as you begin your descent. It is very normal for a pilot under stress to fly faster speeds than usual. This extra speed will impair judgment and will be more difficult to dispose of when the need arises. Use what is required and not a knot more.

The last item is the most ticklish from an advocacy standpoint: What if the propeller will not feather?

I said earlier that you should stop it, as the drag is excessive. If your proficiency permits, you should do just that. This is possible only by deliberately approaching Vso. This is initially going to cost altitude, perhaps a thousand feet, because you must retard power significantly on the good engine to avoid loss of control. If this is your only choice, proceed as follows: Retard power on the good engine to around 17 inches. As the air speed decreases through the flap operating range, lower half flaps. Maintain altitude until the airspeed reaches Vso plus five knots. Maintain this airspeed and allow the aircraft to descend. If the windmilling propeller is going to stop, it will now.

Once the prop stops, lower the nose and blend in climb power on the good engine. Do not exceed VXSE until you are sure the prop will not windmill again. If you can reach VYSE without windmilling again, fine. Do not go any faster. Retract the flaps you lowered as you approach VXSE, or earlier if able. The hazards of this operation are obvious, but the advantages could outweigh them, especially in mountainous terrain.

Multi-engine flying should be safer than single-engine flying, and it can be. But it is only as safe as you *habitually* make it. If you normally pick up the gear and retard to climb power as soon as you are airborne, you are setting yourself up.

Have a plan and some definite rules. If you lose an engine (or two—it happened to a friend of mine), it will occur at the engine's choosing, not yours or your instructor's.

Periodically get some dual in basic multi-engine techniques. This will help you evaluate your own proficiency and correct it as necessary.

The foregoing rules are not chipped in stone. You have to fly the airplane you're in, from the airport where you are. When you graduate from the go-when-it's-blue single-engine class into night, IFR, and multi-engine operation, you have left the amateur field for the professional. You had bloody well better train, think, and act like one, or sooner or later you will be in trouble. □

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Edwin W. Lewis, Jr., of Castro Valley, Calif., has no idea of the total flight hours he has racked up since he started flying in 1951, but he has logged about 6,000 hours of instructing time. He became a part-time civilian instructor after four years with the U.S. Air Force at Valdosta, Ga., first as a pilot and then as an instructor, and one year in Southeast Asia flying a Cessna L-19. He holds all ground and flight instructor ratings except rotorcraft, plus flight navigator and flight engineer time. He has been active in the AOPA flight training program, instructing at 17 clinics thus far. Lewis graduated from Hobart College, Geneva, N.Y. He obtained his commercial ticket while a student there.