CESSNA

# Three Ten I

CESSNA

## OWNER'S MANUAL

# ENGINE-OUT PROCEDURES.

## ENGINE-OUT ON TAKE-OFF.
## (With Sufficient Runway Remaiming).

(1) Cut power and decelerate to a stop.

NOTE

The aircraft can be accelerated from a standing start to 100 MPH on the ground, and then decelerated to a stop with heavy braking within 3046 feet of the starting point of the take-off run at sea level, and within 3863 feet of the starting point at 5000 feet altitude (zero wind, hard surface runway, standard conditions, full gross weight).

## ENGINE-OUT AFTER TAKE-OFF—ABOVE 100 MPH.
## (Without Sufficient Runway Ahead).

(1) Throttles -- Full Forward.
(2) Propellers -- High RPM.
(3) Landing Gear -- UP.
(4) Determine Inoperative Engine (idle engine same side as idle foot).
(5) Propeller -- FEATHER (inoperative engine).
(6) Climb Out at 100 MPH.
(7) Accelerate to 116 MPH after Obstacle is Cleared.
(8) Wing Flaps -- UP (if extended) in small increments.
(9) Secure Inoperative Engine as Follows:
  (a) Auxiliary Fuel Pump -- OFF.
  (b) Mixture -- IDLE CUT-OFF.
  (c) Magneto Switches -- OFF.
  (d) Generator Switch -- OFF.
  (e) Fuel Selector Valve -- OFF.

## SUPPLEMENTARY INFORMATION CONCERNING ENGINE-OUT DURING TAKE-OFF.

The most critical time for and engine-out condition in a twin-engine airplane is during a two or three second period late in the take-off run while the airplane is accelerating to a safe engine-out speed. A detailed knowledge of recommended single-engine airspeeds in the table below is essential for safe operation of this airplane.

These speeds should be memorized for instant recollection in an emergency, and it is worthwhile to review them mentally, prior to every take-off. The following paragraphs present a detailed discussion of the problems associated with engine failures during take-off.

| SINGLE-ENGINE AIRSPEED NOMENCLATURE | IAS—MPH |
|---|---|
| 1. Minimum control speed | 85 |
| 2. Recommended safe single engine speed | 100 |
| 3. Best angle-of-climb speed | 105 |
| 4. Best rate-of-climb speed (flaps up) | 116 |

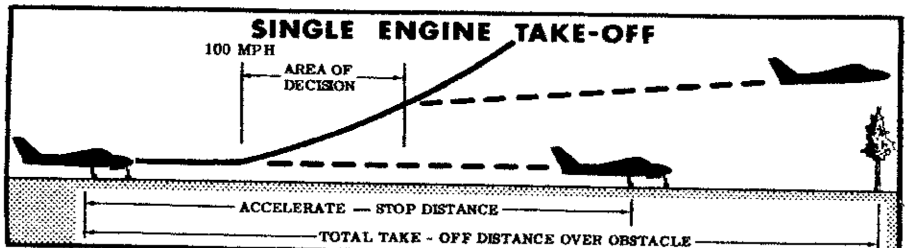
The twin-engine airplane must reach the minimum control speed (85 MPH) before full control deflections can counteract the adverse rolling and yawing tendencies associated with one engine inoperative and full power operation on the other engine. However, although the airplane is controllable at the minimum control speed, the airplane performance is so far below optimum that continued flight near the ground is improbable. A more suitable recommended safe single-engine speed is 100 MPH, since at this speed altitude can be maintained more easily while the landing gear is being retracted and the propeller is being feathered. The best angle-of-climb speed for single-engine operation becomes important when there are obstacles ahead on take-off, because once the best single-engine angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. The best single-engine angle-of-climb speed is approximately 105 MPH with flaps up. For convenience, a speed of 100 MPH may be used for any flap setting between 0 - 15°.

The best rate-of-climb speed for single-engine operation becomes important when there are no obstacles ahead on take-off, or when it is difficult to maintain or gain altitude in single-engine emergencies. The best single-engine rate-of-climb speed is 116 MPH with flaps up, at sea level.

The variation of flaps-up best rate-of-climb speed with altitude is shown in Section VI. For best climb performance, the wings should be banked 5° toward the operative engine.

Upon engine failure after reaching 100 MPH on take-off, the twin-engine pilot has a significant advantage over a single-engine pilot, for he has the choice of stopping or continuing the take-off. This would be similar to the choice facing a single-engine pilot who has suddenly lost slightly more than half of his take-off power. In this situation, the single-engine pilot would be extremely reluctant to continue the take-off if he had to climb over obstructions. However, if the failure occurred at an altitude as high or higher than surrounding obstructions, he would feel free to maneuver for a landing back at the airport.

Fortunately the airplane accelerates through this area where it is "low and slow" in just a few seconds. However, to make an intelligent decision in this type of an emergency, one must consider the field length, obstruction height, field elevation, air temperature, headwind, and the gross weight. The flight paths illustrated in the figure below indicate that the "area of decision" is bounded by: (1) the point at which 100 MPH is reached and (2) the point where the obstruction altitude is reached. An engine failure in this area requires an immediate decision. Beyond this area, the airplane, within the limitations of single-engine climb performance shown in Section VI, may be maneuvered to a landing back at the airport.




At sea level, with zero wind and 5100 pounds gross weight, the distance to accelerate to 100 MPH and stop is 3046 feet, while the total unobstructed area required to take-off and climb over a 50-foot obstacle after an engine failure at 100 MPH is 3720 feet. This total distance over an obstacle can be reduced slightly under more favorable conditions of gross weight, headwind, or obstruction height. However, it is recommended that in most cases it would be better to discontinue the take-off, since any slight mismanagement of single-engine procedure would more than offset the small distance advantage offered by continuing the take-off. The advantage of discontinuing the take-off is even more obvious at higher altitudes where the corresponding distances are 3411 and 4970 respectively, at 2500 feet. Still higher field elevations will cause the engine-out take-off distance to lengthen disproportionately until an altitude is reached where a successful take-off is improbable unless the airspeed and height above the runway at engine failure are great enough to allow a slight deceleration and altitude loss while the airplane is being prepared for a single-engine climb.

During single-engine take-off procedures over an obstacle, only one condition presents any appreciable advantage, and this is headwind. A decrease of approximately 10% in ground distance required to clear a 50-foot obstacle can be gained for each 10 MPH of headwind. Excessive speed above best single-engine climb speed at engine failure is not nearly as advantageous as one might expect since deceleration is rapid and ground distance is used up quickly at higher speeds while the airplane is being cleaned up for climb. However, the extra speed is important for controllability.

The following facts should be used as a guide at the time of engine failure: (1) discontinuing a take-off upon engine failure is advisable under most circumstances; (2) altitude is more valuable to safety after take-off than is airspeed in excess of the best single-engine climb speed since excess airspeed is lost much more rapidly than is altitude; (3) climb or continued level flight at moderate altitude is improbable with the landing gear extended and the propeller windmilling; (4) in no case should the airspeed be allowed to fall below the engine-out best angle-of-climb speed, even though altitude is lost, since this speed will always provide a better chance of climb, or a smaller altitude loss, than any lesser speed. The engine-out best rate-of-climb speed will provide the best chance of climb or the least altitude loss, and is preferable unless there are obstructions which make a steep climb necessary.

Engine-out procedures should be practiced in anticipation of an emergency. This practice should be conducted at a safe altitude, with full power operation on both engines, and should be started at a safe speed of at least 120 MPH. As recovery ability is gained with practice, the starting speed may be lowered in small increments until the feel of the airplane in emergency conditions is well known. Practice should be continued until: (1) an instinctive corrective reaction is developed, and the corrective procedure is automatic; and (2), airspeed, altitude, and heading can be maintained easily while the airplane is being prepared for a climb. In order to simulate an engine failure, set both engines at full power operation, then at a chosen speed pull the mixture control of one engine into IDLE CUT-OFF, and proceed with single-engine emergency procedures.

## TWIN ENGINE CLIMB DATA

| Gross Weight Pounds | At Sea Level and 59°F | | | At 5000 Ft and 41°F | | | At 10,000 Ft and 23° F | | | At 15,000 Ft and 5° F | | | At 20,000 Ft and -12° F | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Best Climb IAS mph | Rate of Climb Ft/Min | Gals. of Fuel Used | Best Climb IAS mph | Rate of Climb Ft/Min | Gals. From S. L. Fuel Used | Best Climb IAS mph | Rate of Climb Ft/Min | Gals. From S. L. Fuel Used | Best Climb IAS mph | Rate of Climb Ft/Min | Gals. From S. L. Fuel Used | Best Climb IAS mph | Rate of Climb Ft/Min | Gals. From S. L. Fuel Used |
| 4300 | 109 | 2070 | 4.0 | 108 | 1650 | 5.8 | 107 | 1240 | 7.7 | 105 | 825 | 10.0 | 104 | 410 | 13.4 |
| 4700 | 115 | 1795 | 4.0 | 114 | 1405 | 6.1 | 113 | 1020 | 8.4 | 112 | 640 | 11.3 | 111 | 255 | 16.3 |
| 5100 | 121 | 1590 | 4.0 | 120 | 1220 | 6.4 | 119 | 855 | 9.1 | 118 | 490 | 12.7 | 117 | 120 | 20.4 |

NOTE: FULL THROTTLE, 2625 RPM, MIXTURE AT RECOMMENDED LEANING SCHEDULE, FLAPS AND GEAR UP. FUEL USED INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE.

## SINGLE ENGINE CLIMB DATA

| Gross Weight Pounds | At Sea Level and 59°F | | At 2500 Ft and 50°F | | At 5000 Ft and 41°F | | At 7500 Ft and 32° F | | At 10,000 Ft and 23° F | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Best Climb IAS mph | Rate of Climb Ft/Min | Best Climb IAS mph | Rate of Climb Ft/Min | Best Climb IAS mph | Rate of Climb Ft/Min | Best Climb IAS mph | Rate of Climb Ft/Min | Best Climb IAS mph | Rate of Climb Ft/Min |
| 4300 | 112 | 560 | 109 | 440 | 108 | 325 | 106 | 210 | 105 | 90 |
| 4700 | 113 | 460 | 112 | 345 | 110 | 235 | 109 | 125 | 107 | 20 |
| 5100 | 116 | 360 | 114 | 255 | 113 | 155 | 112 | 50 | 111 | -55 |

NOTE: FLAPS AND GEAR UP, INOPERATIVE PROPELLER FEATHERED, WING BANKED 5° TOWARD OPERATING ENGINE, FULL THROTTLE, 2625 RPM AND MIXTURE AT RECOMMENDED LEANING SCHEDULE. DECREASE RATE OF CLIMB 10 FT/MIN FOR EACH 10°F ABOVE STANDARD TEMPERATURE FOR PARTICULAR ALTITUDE.

Figure 6-5.