SECTION III
EMERGENCY PROCEDURES

ENGINE-OUT PROCEDURES

ENGINE-OUT ON TAKEOFF
(With Sufficient Runway Remaining)

(1) Cut power and decelerate to a stop.

NOTE

The airplane can be accelerated from a standing start to 105 MPH on the ground, and then decelerated to a stop with heavy braking within 3267 feet of the starting point of the takeoff run at sea level, and within 4527 feet of the starting point at 5000 feet altitude (zero wind, hard surface runway, standard conditions, full gross weight).

ENGINE-OUT AFTER TAKEOFF—ABOVE 105 MPH
(Without Sufficient Runway Ahead)

(1) Mixture -- Full rich.
(2) Propellers -- Full forward.
(3) Throttles -- Full forward.
(4) Landing Gear -- UP.
(5) Determine inoperative engine (idle engine same side as idle foot).
(6) Inoperative propeller -- FEATHER.
(7) Establish Bank -- 5° toward good engine.
(8) Climb Out to Clear Obstacle -- 105 MPH.
(9) Accelerate to 120 MPH after obstacle is cleared.
(10) Wing Flaps -- UP (if extended) in small increments.
(11) Trim Tabs -- Adjust 5° bank toward good engine.
(12) Secure inoperative engine as follows:
  (a) Mixture -- IDLE CUT-OFF.
  (b) Fuel Selector -- OFF.
  (c) Auxiliary Fuel Pump -- OFF.
  (d) Magneto Switches -- OFF.
  (e) Alternator Switch -- OFF.
(13) As Soon as Practical -- LAND.

SUPPLEMENTARY INFORMATION CONCERNING ENGINE-OUT DURING TAKEOFF

The most critical time for an engine-out condition in a twin-engine airplane is during a two or three second period late in the takeoff run while the airplane is accelerating to a safe engine-out speed. A detailed knowledge of recommended single-engine airspeeds, Figure 3-1, is essential for safe operation of this airplane.

The airspeed indicator is marked with a Red radial line at the minimum single-engine control speed and a Blue line at the best single-engine rate-of-climb speed to facilitate instant recognition. The following paragraphs present a detailed discussion of the problems associated with engine failures during takeoff.

SINGLE-ENGINE AIRSPEED NOMENCLATURE	IAS—MPH
1. Minimum control speed (red line)	87
2. Recommended safe single-engine speed	105
3. Best angle-of-climb speed	108
4. Best rate-of-climb speed (flaps up) (blue line)	120

Figure 3-1

MINIMUM CONTROL SPEED. The twin-engine airplane must reach the minimum control speed (87 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. This speed is indicated by a Red radial line on the airspeed indicator.

RECOMMENDED SAFE SINGLE-ENGINE SPEED. 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 105 MPH, since at this speed, altitude can be maintained more easily while the landing gear is being retracted and the propeller is being feathered.

BEST ANGLE-OF-CLIMB SPEED. The best angle-of-climb speed for single-engine operation becomes important when there are obstacles ahead on takeoff, 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 108 MPH with flaps up. For convenience, a speed of 105 MPH may be used for any flap setting between 0 -15°.

BEST RATE-OF-CLIMB SPEED (FLAPS UP). The best rate-of-climb speed for single-engine operation becomes important when there are no obstacles ahead on takeoff, or when it is difficult to maintain or gain altitude in single-engine emergencies. The best single-engine rate-of-climb speed is 120 MPH with flaps up below 16,000 feet. This speed is indicated by a blue radial line on the airspeed indicator. 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 105 MPH on takeoff, the twin-engine pilot has a significant advantage over a single-engine pilot, for he has the choice of stopping or continuing the takeoff. This would be similar to the choice facing a single-engine pilot who has suddenly lost slightly more than half of his takeoff power. In this situation, the single-engine pilot would be extremely reluctant to continue the takeoff 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 of decision" 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 Figure 3-2 indicate that the "area of decision" is bounded by: (1) the point at which 105 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.

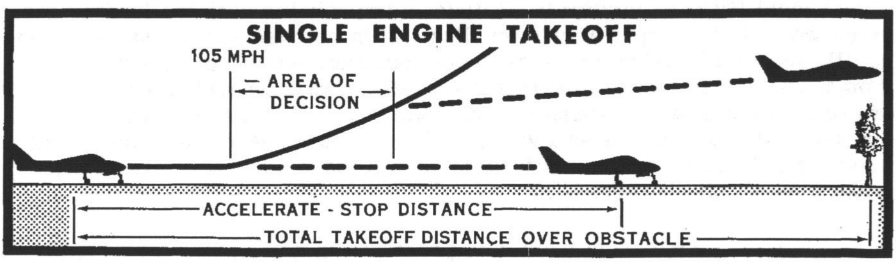


Figure 3-2

At sea level, with zero wind and 5200 pounds gross weight, the distance to accelerate to 105 MPH and stop is 3267 feet, while the total unobstructed area required to takeoff and climb over a 50-foot obstacle after an engine failure at 105 MPH is 4150 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 takeoff, since any slight mismanagement of the single-engine procedure would more than offset the small distance advantage offered by continuing the takeoff. The advantage of discontinuing the takeoff is even more obvious at higher altitudes where the corresponding distances are 3798 and 7994 respectively, at 2500 feet. Still higher field elevations will cause the engine-out takeoff distance to lengthen disproportionately until an altitude is reached where a successful takeoff 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 takeoff procedures over an obstacle, only one condition presents any appreciable advantage, and this is headwind. A decrease of approximately 1% in ground distance required to clear a 50-foot obstacle can be gained for each 1 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 takeoff upon engine failure is advisable under most circumstances; (2) altitude is more valuable to safety after takeoff 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. Simulated single-engine procedures can also be practiced by setting propeller RPM for zero thrust as shown in Figure 3-3.

ENGINE-OUT DURING FLIGHT

(1) Determine inoperative engine (idle engine same side as idle foot).
(2) Power -- Increase as required.
(3) Mixture -- Adjust for altitude.

Before securing inoperative engine:

(1) Fuel Flow -- Check, if deficient, position auxiliary fuel pump switch to ON.

NOTE

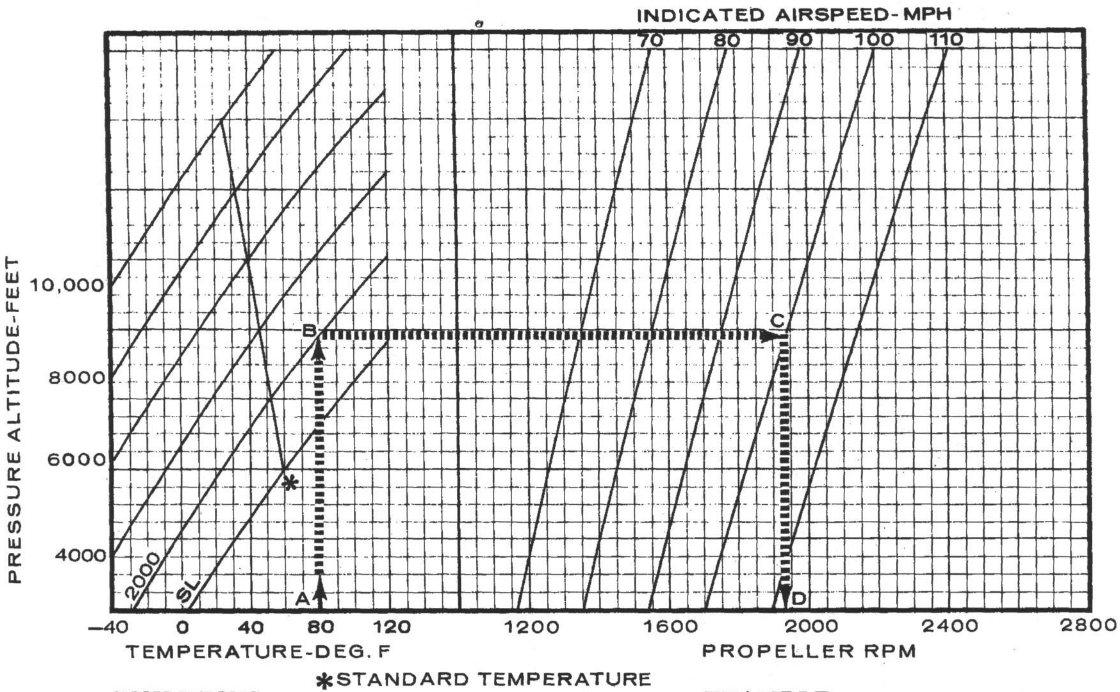
If fuel selector valve is in AUXILIARY TANK position, switch to MAIN TANK and feel for detent.

(2) Fuel Quantity -- Check, and switch to opposite MAIN TANK if necessary.
(3) Oil Pressure and Oil Temperature -- Check, shutdown engine if oil pressure is low.
(4) Magneto Switches -- Check.

If proper corrective action was taken, engine will restart. If it does not, secure as follows:

(5) Inoperative Engine -- SECURE.
 (a) Throttle -- CLOSED.
 (b) Mixture -- IDLE CUT-OFF.
 (c) Propeller -- FEATHER.
 (d) Fuel Selector -- OFF.
 (e) Auxiliary Fuel Pump -- OFF.

PROPELLER RPM FOR ZERO THRUST



CONDITIONS:

1. Propeller Control Full High RPM - Full Low Pitch (13°)
2. Manifold Pressure Adjusted to Obtain Proper RPM.

EXAMPLE:

A. Temperature - 80° F.
B. Pressure Altitude - 2000 Ft.
C. Airspeed - 100 MPH IAS.
D. Propeller Speed - 1940 RPM.

Figure 3-3

(f) Magneto Switch -- OFF.
(g) Alternator Switch -- OFF.

(6) Operative Engine -- ADJUST.
   (a) Power -- INCREASE, as required.
   (b) Mixture -- ADJUST for power.
   (c) Fuel Selector -- MAIN TANK (feel for detent).
   (d) Auxiliary Fuel Pump -- ON.
(7) Trim Tabs -- ADJUST (5° bank toward good engine).
(8) Electrical Load -- DECREASE to maintain a positive battery.
(9) As Soon as Practical -- LAND.

ENGINE RESTARTS IN FLIGHT (After Feathering)

AIRPLANES WITHOUT OPTIONAL PROPELLER UNFEATHERING SYSTEM INSTALLED

(1) Fuel Selector Valve -- MAIN (feel for detent).
(2) Throttle -- Advance until gear warning horn is silent.
(3) Propeller -- HIGH RPM.

NOTE

With the optional propeller unfeathering system installed, the propeller will automatically windmill when the propeller lever is moved to the HIGH RPM position. As propeller unfeathers and starts to windmill, decrease propeller lever to cruise position.

(4) Mixture -- FULL RICH.
(5) Magneto Switches -- ON.
(6) Starter Button -- Press.
(7) Primer Switch -- Engage.
(8) Starter Button and Primer Switch -- Release when engine fires.
(9) Power -- Increase slowly until cylinder head temperature reaches 200°F.

NOTE

If start is unsuccessful, turn magneto switches OFF, retard mixture to IDLE CUT-OFF, open throttle fully, and engage starter for several revolutions. Then repeat air start procedures.

AIRPLANES WITH OPTIONAL PROPELLER UNFEATHERING SYSTEM INSTALLED

(1) Magneto Switches -- ON.
(2) Throttle -- FORWARD approximately one inch.
(3) Mixture -- FULL RICH.
(4) Propeller -- FULL FORWARD.

NOTE

The propeller will automatically windmill when the propeller lever is moved out of the FEATHER position.

(5) Propeller -- RETARD to detent when propeller reaches 1000 RPM.

MAXIMUM GLIDE

In the event of a double engine-out condition, maximum gliding distance can be obtained by feathering both propellers, and maintaining approximately 110 MPH with the landing gear and wing flaps up. Refer to the Maximum Glide Diagram, Figure 3-4, for maximum glide data.

SINGLE-ENGINE APPROACH AND LANDING

(1) Approach at 110 MPH with excess altitude.
(2) Delay extension of landing gear until within gliding distance of field.
(3) Avoid use of flaps until landing is assured.
(4) Decrease speed below 105 MPH only if landing is a certainty.

FORCED LANDING (Precautionary Landing with Power)

(1) Drag over selected field with flaps 15° and 105 MPH airspeed, noting type of terrain and obstructions.
(2) Plan a wheels-down landing if surface is smooth and hard (pasture, frozen lake, etc.).
(3) Execute a normal short-field landing, keeping nosewheel off ground until speed is decreased.
(4) If terrain is rough or soft, plan a wheels-up landing as follows:
  (a) Select a smooth grass-covered runway, if possible.
  (b) Landing Gear Switch -- UP.
  (c) Approach at 105 MPH with flaps down only 20°.
  (d) All Switches Except Ignition Switches -- OFF.

(e) Unlatch cabin door prior to flare-out.

IMPORTANT

Be prepared for a mild tail buffet as the cabin door is opened.

(f) Mixtures -- IDLE CUT-OFF (both engines).
(g) Ignition Switches -- OFF.
(h) Fuel Selector Valve Handles -- OFF.
(i) Land in a slightly tail-low attitude.

NOTE

Airplane will slide straight ahead about 500 feet on smooth sod with very little damage.

FORCED LANDING (Complete Power Loss)

(1) Mixtures -- IDLE CUT-OFF.
(2) Feather propellers and rotate them to a HORIZONTAL position with starter, if time permits.
(3) Fuel Selector Valve Handles -- OFF.

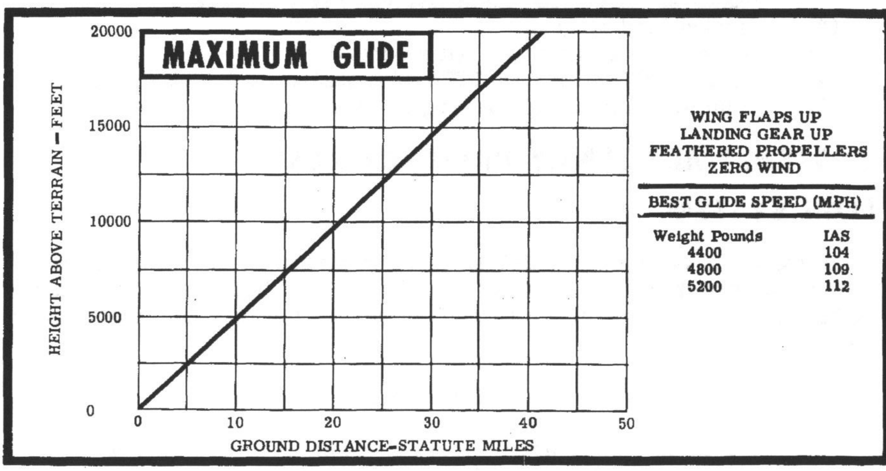


Figure 3-4

(4) All Switches Except Battery Switch -- OFF.
(5) Approach at 116 MPH.
(6) If field is smooth and hard, extend landing gear when within gliding distance of field.
(7) Extend flaps as necessary when within gliding distance of field.
(8) Battery Switch -- OFF.
(9) Make a normal landing, keeping nosewheel off the ground as long as practical.
(10) If terrain is rough or soft, plan a wheels-up landing as follows:
   (a) Select a smooth, grass-covered runway if possible.
   (b) Landing Gear Switch -- UP.
   (c) Approach at 105 MPH with flaps down only 20°.
   (d) Battery Switch -- OFF.
   (e) Unlatch cabin door prior to flare-out.

IMPORTANT

Be prepared for a mild tail buffet as cabin door is opened.

   (f) Land in a slightly tail-low attitude.

GO-AROUND (SINGLE-ENGINE)

(1) If absolutely necessary and speed is above 105 MPH, increase engine speed to 2625 RPM and apply full throttle.
(2) Retract landing gear.
(3) Reduce flap setting to 0° (if extended).
(4) Climb at 120 MPH (108 MPH with obstacles directly ahead).
(5) Trim airplane for single-engine climb.

SYSTEM EMERGENCY PROCEDURES

FUEL SYSTEM

In the event of an engine-driven fuel pump failure, turn the auxiliary fuel pump switch (on the inoperative side) to ON. This pump will supply sufficient fuel for emergency takeoff; however, the mixture control must be reset.

IMPORTANT

If both an engine-driven fuel pump and an auxiliary fuel pump fail on the same side of the airplane, the failing engine cannot be supplied with fuel from the opposite MAIN tank since that auxiliary fuel pump will operate on the low pressure setting as long as the corresponding engine fuel pump is operative.

ELECTRICAL SYSTEM

ALTERNATOR FAILURE

(1) Alternator Switch -- OFF.

DUAL ALTERNATOR FAILURE

(1) Overvoltage Protector -- RESET if out.
(2) Voltage Regulator Switch -- STBY if alternators fail to function.
(3) IF ALTERNATORS ARE STILL INOPERATIVE, PROCEED AS FOLLOWS:
  (a) Alternator Switches -- OFF.
  (b) Battery Switch -- OFF.
  (c) Reduce electrical load to a minimum.
  (d) Emergency Power Switch -- ON.
  (e) Left Alternator Switch -- ON.
  (f) Right Alternator Switch -- ON.
(4) IF ALTERNATORS ARE STILL INOPERATIVE, PROCEED AS FOLLOWS:
  (a) Emergency Power Switch -- OFF.
  (b) Alternator Switches -- OFF.
  (c) Battery Switch -- ON.
  (d) Prepare to terminate flight.

FLIGHT INSTRUMENTS

OBSTRUCTION OR ICING OF STATIC SOURCE

(1) Alternate Static Source -- OPEN.
(2) Excess Altitude and Airspeed -- MAINTAIN to compensate for change in calibration. Increase indicated airspeed approximately 10 MPH and altitudes approximately 80 feet. Refer to Pilot's Checklist for accurate calibration.

VACUUM PUMP FAILURE

(1) Red indicator on gage will show failure.
(2) Automatic valve will select operative source.

LANDING GEAR SYSTEM

LANDING GEAR WILL NOT EXTEND ELECTRICALLY

When the landing gear will not extend electrically, it may be extended manually in accordance with the following steps:

(1) Before proceeding manually, check landing gear circuit breakers with landing gear switch DOWN. If circuit breakers are tripped, allow 3 minutes for them to cool before resetting.
(2) Landing Gear Switch -- NEUTRAL (center)
(3) Pilot's Seat -- TILT full aft.
(4) Hand Crank -- EXTEND AND LOCK. (Ref. Figure 2-6.)
(5) Rotate Crank -- CLOCKWISE four turns past point where gear-
(6) down lights come on (approximately 52 turns).
Gear-Down Lights -- CHECK.
(7) Gear Warning Horn -- CHECK with throttle retarded.
(8) Hand Crank -- PUSH BUTTON and STOW.
(9) As Soon as Practical -- LAND.

IF LANDING GEAR WILL NOT RETRACT ELECTRICALLY

(1) Do not try to retract manually.

NOTE

The landing gear should never be retracted with the manual system, as undue loads will be imposed and cause excessive wear on the cranking mechanism.

(2) Landing Gear -- DOWN.
(3) Gear-Down Lights -- CHECK.
(4) Gear Warning Horn -- CHECK.
(5) As Soon as Practical -- LAND.

LANDING EMERGENCIES

LANDING WITH FLAT MAIN GEAR TIRE

If a blowout occurred during takeoff, and the defective main gear tire is identified, proceed as follows:

(1) Landing Gear Switch -- UP.
(2) Fuel Selector Valve Handles -- Turn to main tank on same side as defective tire and feel for detent. Proceed to destination to reduce fuel load.

NOTE

Fuel should be used from this tank first to lighten the load on this wing prior to attempting a landing, if in-flight time permits. However, an adequate supply of fuel should be left in this tank so that it may be used during landing.

(3) Fuel Selectors - Left Engine -- LEFT MAIN (feel for detent).
Right Engine -- RIGHT MAIN (feel for detent).
(4) Select a runway with a crosswind from the side opposite the defective tire, if a crosswind landing is required.
(5) Landing Gear Switch -- DOWN (below 160 MPH).
(6) Check landing gear down indicator lights (green) for indication.
(7) Flaps Switch -- DOWN. Fully extend flaps to 35°.
(8) In approach, align airplane with edge of runway opposite the defective tire, allowing room for a mild turn in the landing roll.
(9) Land slightly wing-low on side of inflated tire and lower nosewheel to ground immediately, for positive steering.
(10) Use full aileron in landing roll, to lighten load on defective tire.
(11) Apply brake only on the inflated tire, to minimize landing roll and maintain directional control.
(12) Stop airplane to avoid further tire and wheel damage, unless active runway must be cleared for other traffic.

LANDING WITH FLAT NOSE GEAR TIRE

If a blowout occurred on the nose gear tire during takeoff, prepare for a landing as follows:

(1) Landing Gear Switch -- Leave DOWN.

IMPORTANT

Do not attempt to retract the landing gear if a nose gear tire blowout occurs. The nose gear tire may be distorted enough to bind the nosewheel strut within the wheel well and prevent later gear extension.

(2) Move disposable load to baggage area and passengers to available rear seat space.
(3) Flaps Switch -- DOWN. Extend flaps from 0° to 20°, as desired.
(4) Land in a nose-high attitude with or without power.
(5) Maintain back pressure on control wheel to hold nosewheel off the ground in landing roll.
(6) Use minimum braking in landing roll.
(7) Throttles -- Retard in landing roll.
(8) As landing roll speed diminishes, hold control wheel fully aft until airplane is stopped.
(9) Avoid further tire damage by holding additional taxi to a minimum.

LANDING WITH DEFECTIVE MAIN GEAR

Reduce the fuel lo .d in the tank on the side of the faulty main gear as explained in paragraph LANDING WITH FLAT MAIN GEAR TIRE. When fuel load is reduced, prepare to land as follows:

(1) Fuel Selectors - Left Engine -- LEFT MAIN (feel for detent).
Right Engine -- RIGHT MAIN (feel for detent).
(2) Select a wide, hard surface runway, or if necessary a wide sod runway. Select a runway with crosswind from the side opposite the defective landing gear, if a crosswind landing is necessary.
(3) Landing Gear Switch -- DOWN.
(4) Flaps Switch -- DOWN. Extend flaps to 30°.
(5) In approach, align airplane with edge of runway opposite the defective landing gear, allowing room for a ground-loop in landing roll.
(6) Battery Switch -- OFF.
(7) Land slightly wing-low toward the operative landing gear and lower the nosewheel immediately, for positive steering.
(8) Mixture Levers -- IDLE CUT-OFF (both engines).
(9) Use full aileron in landing roll to lighten the load on the defective landing gear.
(10) Apply brake only on the operative landing gear to maintain directional control and minimize the landing roll.
(11) Fuel Selector Valve Handles -- OFF.
(12) Evacuate the airplane as soon as it stops.

LANDING WITH DEFECTIVE NOSE GEAR

Sod Runway—Main Gear Retracted

This procedure will produce a minimum amount of airplane damage on smooth runways. This procedure is also recommended for short, rough, or uncertain field conditions where passenger safety, rather than minimum airplane damage, is the prime consideration.

(1) Select a smooth, grass-covered runway, if possible.
(2) Landing Gear Switch -- UP.
(3) Approach at 105 MPH with flaps down only 20°.
(4) All Switches Except Ignition Switches -- OFF.
(5) Unlatch cabin door prior to flare-out.

IMPORTANT

Be prepared for mild tail buffet as the cabin door is opened.

(6) Land in a slightly tail-low attitude.
(7) Mixture Levers -- IDLE CUT-OFF (both engines).
(8) Magneto Switches -- OFF.
(9) Fuel Selector Valve Handles -- OFF.

Smooth Hard Surface Runway — Main Gear Extended

(1) Move disposable load to baggage area, and passengers to available rear seat space.
(2) Select a smooth, hard surface runway.
(3) Landing Gear Switch -- DOWN.
(4) Approach at 105 MPH with flaps down 20°.
(5) All Switches Except Ignition Switches -- OFF.
(6) Land in a slightly tail-low attitude.
(7) Mixture Levers -- IDLE CUT-OFF (both engines).
(8) Magneto Switches -- OFF.
(9) Hold nose off throughout ground roll - Lower gently as speed dissipates.

DITCHING

(1) Plan approach into wind, if winds are high and seas are heavy. With heavy swells and light wind, land parallel to swells, being careful not to allow wing tip to hit first.
(2) Approach with landing gear retracted, flaps 35°, and enough power to maintain approximately 200 ft/min. rate-of-descent at approximately 108 MPH at 4600 pounds gross weight.

(3) Maintain a continuous descent until touchdown, to avoid flaring and touching down tail-first, pitching forward sharply, and decelerating rapidly. Strive for initial contact at fuselage area below rear cabin section (point of maximum longitudinal curvature of fuselage).