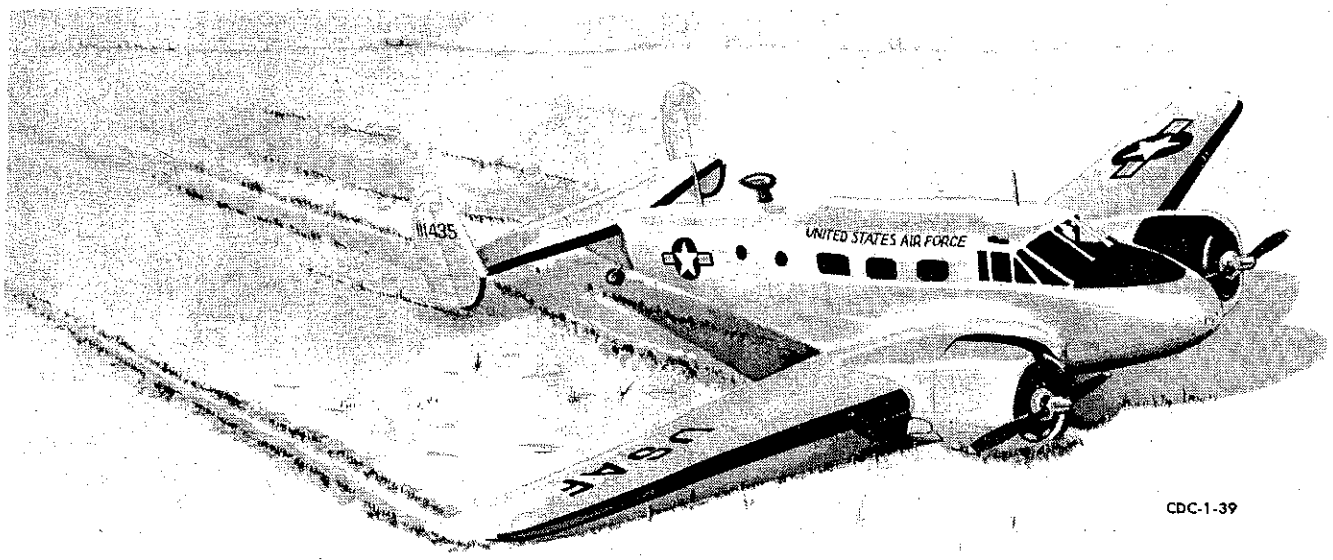


section III EMERGENCY PROCEDURES

INTRODUCTION.

The degree of emergencies, created by the failure or malfunctioning of one or more components or accessories, will be minimized by a complete understanding of the factors involved and by immediate initiation of the proper procedures as discussed in this section. Description of emergency systems and equipment will be found in Sections I and IV.

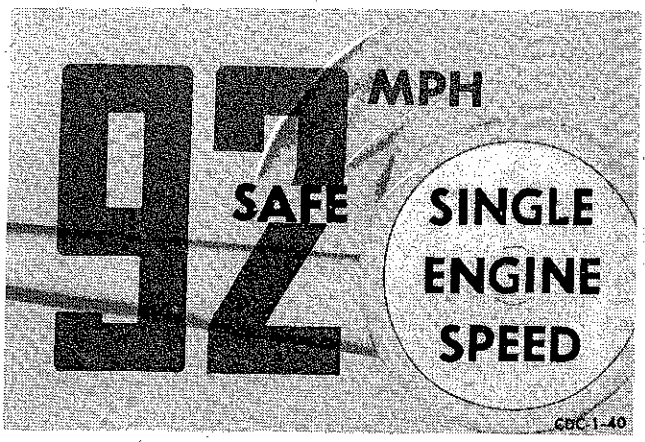
ENGINE FAILURE.

The loss of power from one engine, with this aircraft, creates no radical or unconventional tendencies. It does present the problems of diminished and unbalanced power. Diminished power will be noticed in decreased performance, either lost airspeed or altitude, or both. The unbalanced power will be evident in the yawing toward the dead engine. These immediate effects of engine failure are the factors that require immediate attention and compensation. Your primary concern is the maintenance of altitude, airspeed and directional control. YOU MUST FLY THE AIRCRAFT.

In maintaining altitude and airspeed, maximum power from the operating engine can be used.

Directional control can be effected by the flight controls. The amount of rudder required to maintain straight flight depends on two variables; the effect of control, that is, the amount of air flowing past the rudder, and the amount of yaw caused by the unbalanced power. It can be readily appreciated that the more power applied by the operating engine, the more yaw; and the more yaw, the more control effect required to offset it. From this comes the one most important single point to be remembered: THE MINIMUM SINGLE ENGINE CONTROL SPEED IS 92 MPH (80 KNOTS) IAS. This is the speed necessary to produce the required effect of rudder to control the aircraft under conditions of single engine operation at TAKE-OFF power.

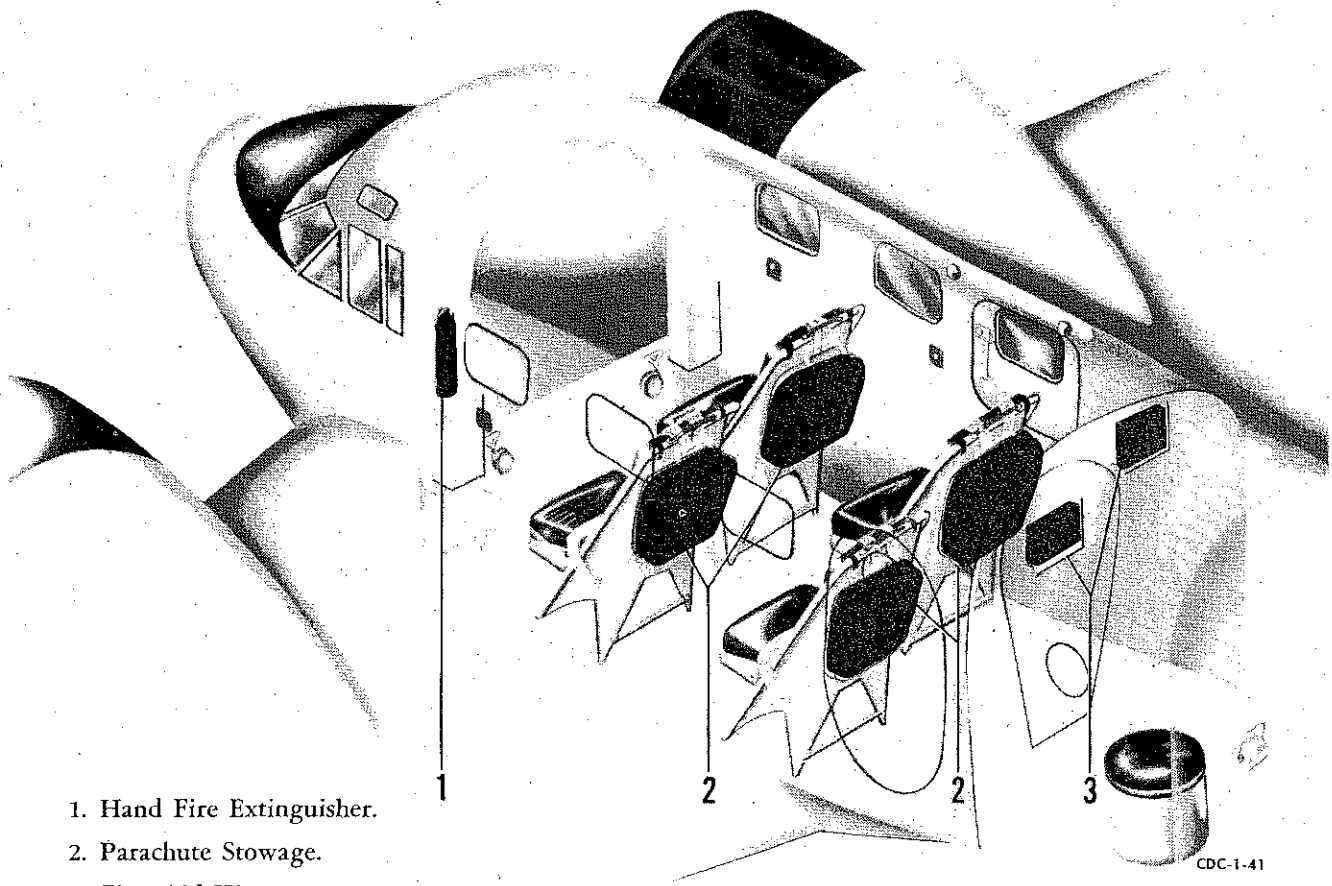
The electrical system is so designed that when a generator becomes inoperative, it automatically becomes disconnected from the circuit. However, as discussed later in this section, loss of one generator has far-reaching results.



SINGLE ENGINE PROCEDURE.

The procedure to be followed in preparing for single engine flight is divided into two categories. First, the preliminary, including those steps necessary to get the engine stopped and to prepare to fight possible engine fire. Second, those steps necessary to completely shut down the engine for continued single engine operation. Keep in mind that this procedure is for engine malfunction and you are preparing for a possible resulting fire. The procedure in the case of actual engine fire is slightly different, as discussed later in this section.

EMERGENCY EQUIPMENT



1. Hand Fire Extinguisher.
2. Parachute Stowage.
3. First Aid Kits.

Figure 3-1

SINGLE ENGINE PROCEDURE.

NOTE

On encountering engine failure it is necessary to maintain altitude, airspeed and directional control. It may be necessary to advance the power on the good engine to assist in maintaining airspeed and altitude.

Throttle — CLOSED (inoperative engine).

Propeller Feathering Button — PUSH (inoperative engine).

Mixture Lever — IDLE CUT-OFF (inoperative engine).

Engine Fuel Selector Handle — OFF (inoperative engine).

Cowl Flaps — TRAIL (inoperative engine).

Ignition — OFF (inoperative engine).

The steps to this point are the preliminary steps. The following steps are those required for continued single engine operation.

Boost Pump — Check OFF (inoperative engine).

Mixture Lever — RICH (operating engine).

Adjust power on the operating engine.

NOTE

Varying situations require different power adjustment on the remaining engine. These are brought out later in this section.

Landing Gear Lever — UP.

Flap Lever — UP.

Operating Engine Fuel Selector Handle — FRONT TANK.

Fuel Cross-Feed Handle — OFF.

NOTE

When the inoperative engine is sufficiently cool, cowl flaps may be closed to reduce drag.

Oil Shutter Button — CLOSED (inoperative engine).

Generator Switch — OFF (inoperative engine).
Remove all non-essential electrical loads from the aircraft electrical system.
Trim aircraft for single-engine flight.

NOTE

In all single engine operation, the temperatures of the operating engine will rise. Temperatures will require frequent checking to assure that they are maintained within the operating limits.

RESTARTING ENGINE IN FLIGHT.

The following procedure should be followed in restarting an engine in flight and for resumption of normal flight.

NOTE

An engine should not be restarted unless the condition which required the feathering has been alleviated and it can be determined it will be safe to do so.

Engine Fuel Selector Handle — FRONT TANK.
Ignition Switch — BOTH.
Throttle — 1/8 open.
Fuel Booster Switch — ON.
Propeller — Unfeather.
Mixture Lever — RICH (after engine is turning).
Throttles — Adjust for warm-up (15 to 18 inches Hg.).

NOTE

When temperatures are such that little warm-up is required, 15 inches Hg. manifold pressure will suffice. Under colder conditions 18 inches Hg. may be required.

Fuel Booster Switch — OFF.
Generator Switch — ON.
Oil Shutter Button — Closed until oil temperature is above operating minimums. Then as required.
Cowl Flap Handle — Closed until cylinder head temperatures are above operating minimums. Then as required.
When all temperatures are above the operating minimums, equalize the power settings for the engines.
Retrim the aircraft.
Mixture Lever — Adjust.
Engine Fuel Selector Handle — Check.

ENGINE FAILURE DURING TAKE-OFF.

If engine failure occurs on take-off and sufficient runway remains ahead of the aircraft, cut power on the remaining engine and land. Order all occupants to abandon the aircraft and assign one to the engine that failed with the portable fire extinguisher. Stand by to fight possible engine fire.

If engine failure occurs during take-off and sufficient runway to land does not remain ahead of the aircraft, but airspeed is above "Minimum Single Engine Control Speed," complete the "Single Engine Procedure." Utilize Take-Off Power until all obstructions are cleared and the climb is established, then reduce to a climb power, climbing at 110 mph (95 knots) IAS. A landing should be made as soon as practicable. After landing, secure the aircraft and stand by to fight possible engine fire as previously discussed.

If engine failure occurs during take-off at an airspeed below "Minimum Single Engine Control Speed," reduce power on the remaining engine sufficiently to maintain directional control. Prepare to crash-land straight ahead, turning no more than necessary to avoid obstructions. Accomplish as much of the Single Engine Procedure as possible. To minimize the hazard of fire after landing, the Engine Fuel Selectors and Ignition Switches should be placed OFF prior to touch-down. Also lock shoulder harness before landing. After landing, determine that all occupants have escaped, then abandon the aircraft.

If engine failure occurs during take-off run when there is not sufficient distance ahead for stopping with the use of brakes and ground looping is not feasible, the landing gear should be retracted by using the Landing Gear Switch Emergency Release to avoid the danger of cartwheeling when reaching the end of the runway.

ENGINE FAILURE DURING FLIGHT.

If engine failure should occur during flight, accomplish the Single Engine Procedure, adjusting power on the remaining engine as required to maintain altitude and safe airspeed.

Refer to the performance graphs in Appendix I for information regarding airspeed, power settings and fuel consumption for single engine operation. In any event, a landing is to be made as soon as practicable.

FUEL PRESSURE DROP — ENGINE OPERATING NORMALLY.

DURING GROUND OPERATION. If the fuel pressure drops below the operating limits during ground operation, but the engine continues to operate normally, stop the aircraft, set the fire extinguisher selector to the affected engine, and shut down immediately. DO NOT TAKE OFF. Investigate the cause and correct.

DURING FLIGHT. If the fuel pressure drops below the operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage; oil dilution solenoid leakage; engine driven fuel pump bypass valve leakage; clogged pressure line; instrument failure; or line leakage. Possible courses of action, depending on the cause of the pressure drop, are listed as follows:

1. CUT THE ENGINE IMMEDIATELY—Do this if the power is not necessary to sustain flight or to reach a safe destination.

2. CONTINUE OPERATING THE ENGINE NORMALLY—This may be done if it can be unques-

tionably determined that the indicated fuel pressure drop has not resulted from a fuel leak.

3. KEEP THE AFFECTED ENGINE IN OPERATION AT OR ABOVE CRUISING SPEED WHILE MAINTAINING WATCH FOR FIRE—This can be done if it cannot be determined whether or not an actual leak exists and the engine is required to either sustain flight or maintain the required altitude for arrival at a safe destination. However, prior to power reduction for entrance to the landing pattern, cut the affected engine completely (by means of the mixture control—not by retarding the throttle) and accomplish a partial power landing. Unless the added power is absolutely essential to effect a safe landing, do not reduce airspeed until the affected engine is shut down. Too many lives and aircraft have already been lost when the pilot gained a false sense of security as a result of several hours of flight under these circumstances without any indication of fire—then when he reduced power for a landing, an engine fire developed and it became too late to take any corrective action. This required procedure is based on the fact that air flow over the engine and nacelle, due to its cooling and dispersing effect, will frequently serve to keep a fire from breaking out, even though an actual fuel leak exists—that is until the speed of the airplane is reduced sufficiently, as during landing.

NOTE

All other factors being equal, course "1" is generally the best. However, action to be taken depends entirely upon the circumstances existing at the time. Such factors as the known condition of the airplane and the remaining engines, stage and requirements of the mission, and power requirements of the aircraft should be considered.

SINGLE ENGINE LANDING.

Complete the "Pre-Traffic Pattern Check" for the aircraft, as applicable for the operating engine.

Enter the traffic pattern at a minimum of 105 mph (90 knots) IAS. The "Traffic Pattern Check" should be completed and will be the same as for normal landing except that the propellers should be advanced to 2200 rpm and specific airspeeds do not apply.

Since control is more positive and greater control can be exercised when turning toward the operating engine, the pattern should be such that all turns will be, whenever possible, in this direction. The landing gear will normally be lowered early on the final approach. The traffic pattern usually will be larger, with a single engine, because of more shallow turns. This will make lowering the gear after the final turn

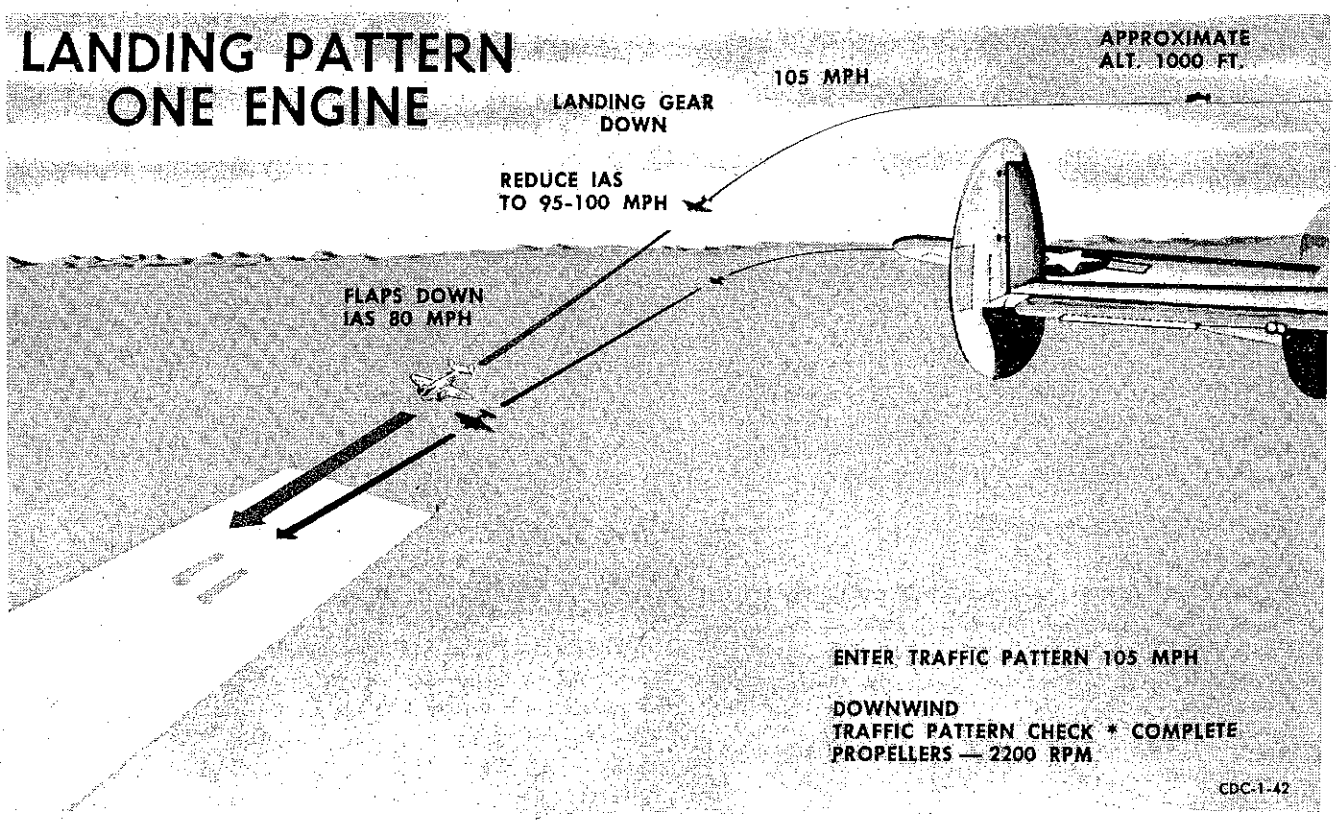


Figure 3-2

quite practical. Should circumstances make lowering the landing gear earlier in that pattern feasible, there is no reason why it may not be lowered; however, keep in mind the effect on altitude and airspeed of the added drag. It will not only require more power to maintain altitude and airspeed, but it will also make the regaining of lost altitude and airspeed more difficult.

Flaps may be used as required during the approach, but since all added drag will reduce performance in the event of a "go around", it is good practice to plan the approach so that no great amount of flap is required until the final stage of the final approach.

Maintain 105 mph (90 knots) IAS in the approach until after the final turn, then reduce power and retrim. Reduce airspeed to not less than "Minimum Single Engine Control Speed." When landing is assured, lower flaps to Full Down and reduce airspeed to 80 mph (70 knots) IAS.

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CAUTION

With landing gear and flaps down and airspeed reduced below the "Minimum Single Engine Control Speed" you are committed to land. Do not attempt a "go around."

If circumstances require a shorter approach, speed may be reduced earlier in the approach. (Never less than Minimum Single Engine Control Speed.) In an approach of this type, speed control in the final turn is very important. If speed is allowed to diminish, control may be lost; if speed is allowed to build up, it may be difficult to slow the aircraft for landing. Once committed to landing, the remaining rudder trim, which was used to compensate for unbalanced power, may be neutralized.

Keep in mind that the power-off glide of the aircraft will be appreciably greater because of the reduced drag with one propeller feathered. Flare out the glide and make a normal landing with added caution against stalling too high since controllable power is not available for recovery.

LANDING WITH NO POWER AVAILABLE.

If it becomes necessary to land the aircraft with no power available, the following procedure should be followed. Complete the Single Engine Procedure as applicable in shutting down both engines with the exception that batteries should be ON.

Warn all occupants.

Utilize the engine starters to position the feathered propellers in a horizontal position.

WARNING

Propellers in a vertical position will dig into the ground on a "wheels-up" landing, greatly increasing the initial shock and also increasing the possibility of fire since wing fuel tanks may be ruptured.

Unbuckle parachute, tighten seat belt and shoulder harness.

Jettison emergency escape doors prior to landing since impact could jam them.

Lower landing gear only when you are certain terrain is suitable and only to conserve battery power, by means of the emergency system.

Make a normal approach. Use flaps as required in the approach and full flap for landing.

NOTE

Keep in mind the variation in glide if the landing gear is not lowered.

After flaps are lowered turn batteries — OFF.

Lock shoulder harness reel.

Execute a nose-high landing, maintaining ample airspeed throughout approach, avoiding a stall condition. After the aircraft has stopped, make certain all occupants have escaped, then abandon the aircraft.

SINGLE ENGINE GO-AROUND.

The procedure for single engine go-around is as follows:

1. Apply full power.
2. Landing Gear — UP.
3. Flaps — UP.
4. Cowl Flap — TRAIL.

As power is applied and the gear raised, establish a climbing attitude and raise the flaps. Normally a go-around will not be attempted from that portion of an approach where full flap is extended, however, if such is the case maintain Minimum Single Engine Control Speed and raise the flaps. If speed has been reduced below Minimum Single Engine Control Speed, or if the landing gear is extended and flaps fully extended, a go-around cannot be accomplished unless sufficient altitude is available to retract the landing gear and flaps, and/or increase speed to that for single engine control.

PROPELLER FAILURE.

If a propeller governor should fail, as indicated by uncontrollable engine speed, complete the Single Engine Procedure, shutting down the engine.

Should a feathering button "pop out" before feathering is complete, the button should be repeatedly pushed in, but not held in, until feathering is complete.

If a propeller fails to completely stop rotating, engine rotation can sometimes be stopped by slightly decreasing airspeed.

When a feathering button fails to "pop out" after feathering is complete, the propeller will begin unfeathering. In this case the propeller should be refeathered and the button pulled out as soon as rotation stops.

CDC-1-43

FIRE.

ENGINE FIRE ON THE GROUND.

Engine fire on the ground is usually an induction system fire which occurs during the starting operation. For this type of fire, proceed as follows:

If the engine has started, keep it running.

Most fires can be pulled through the induction system.

If the engine has not started, place mixture control in IDLE CUT-OFF, the throttle OPEN and continue to turn the engine with the starter in an attempt to extinguish by drawing fire into the engine.

If in either case fire does not extinguish, stop the engine and order ground crew to extinguish with hand extinguishers. If ground crew does not immediately extinguish the fire, discharge the engine extinguishing system.

NOTE

If either or both engines are running when it becomes necessary to combat fire with extinguishers, they should be stopped.

ENGINE FIRE DURING FLIGHT.

Propeller Buttons — PUSH (Inoperative engine).
Mixture Lever — IDLE CUT-OFF (Inoperative engine).
Engine Fuel Selector Handle — OFF (Inoperative engine).
Oil Shutter Lever — CLOSED (Inoperative engine).
Fire Extinguisher Switch — Hold ON.
Cowl Flap Handle — TRAIL.
Ignition Switch — OFF (Inoperative engine).
Landing Gear Lever — DOWN.
Shut down inoperative engine completely.
Do not restart engine.
Land as soon as practicable.

CAUTION

The landing gear actuation system may have been damaged by the fire; therefore, do not retract the gear unless it is absolutely necessary.

NOTE

This procedure is general. The necessity of stopping the engine and extinguishing the fire is paramount and the establishing of adequate power from the remaining engine was intentionally omitted because of greatly varied situations. Where a loss of altitude is not important neither is the immediate application of additional power. In other instances, such as an approach, loss of a few hundred feet may be as hazardous as fire. You must appraise each emergency situation and act accordingly. REMEMBER — NOTHING IN THIS HANDBOOK CAN REPLACE GOOD JUDGMENT.

FUSELAGE FIRE DURING FLIGHT.

Batteries — OFF.
Generators — OFF.

NOTE

If it is determined the fire is not electrical, batteries and generators may be turned ON.

Close all windows and ventilating ducts.
Combat fire with portable extinguisher.

WARNING

CB is toxic, particularly when used to fight a fire in a closed area where various kinds of materials are burning. It is important to use as little CB as possible and to avoid inhaling any more fumes than necessary. Dizziness and Nausea are symptoms of CB poisoning sufficient to require medical attention.

That crew member not combating fire — Stand by to aid others in distress.
Make preparation for emergency landing.

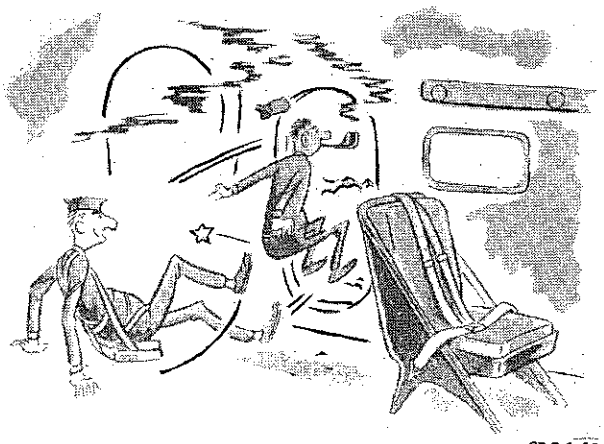
WING FIRE.

1. All electrical circuits into the wing — OFF.
2. Attempt to extinguish the flames by slipping the aircraft (away from the wing on fire).
3. Prepare for an emergency landing and land as rapidly as practicable.

ELECTRICAL FIRE.

1. Follow procedure for fuselage fire.
2. Position all individual electrical switches OFF.
3. Batteries and Generators — ON.
4. Check by switching on individual circuits, one by one, in an attempt to identify which is malfunctioning. When the faulty circuit is determined, all switches and circuit breakers in that circuit must be turned off. The remaining circuits and equipment may then be operated normally.

SMOKE ELIMINATION.



CDC-1-80

After an interior fire has been extinguished, smoke and/or fumes should be eliminated in the following manner:

1. With all other vents and windows closed, open

SMOKE & FLAME IDENTIFICATION

TYPE OF FIRE OR SMOKE	VISUAL INDICATION	POSSIBLE INSTRUMENT INDICATION	POSSIBLE CAUSE	DANGER	REMEDY
Black smoke	Puffs from exhaust and rough engine	High CHT and CAT, fluctuating MP, RPM and F/F	Detonation, afterfire or backfire from lean mix. and/or carb. failure	Loss of power, engine failure	Enrich mixture, reduce power and temperature and monitor engine instruments
Bluish-grey smoke	Thin wisps of smoke from cowl flaps and exhaust areas	Drop in oil quantity	Slight oil leak	Slight possibility of fire	Watch closely and feather if volume of smoke indicates necessity
Grey smoke and possible light flame	Variable quantity from cowl flaps and exhaust areas — rough engine	High CHT, fluctuating MP and RPM and low oil pressure	Cylinder head or exhaust stack failure	Engine failure and fire	Feather procedure and alert crew
Black smoke	Heavy — From exhaust	Sudden drop in MP and RPM, high CHT	Initial induction fire from burning fuel	Uncontrolled fire	Fire and feather procedure and alert crew
White smoke	Dense — From exhaust and/or cowl flap areas	Very high CHT and CAT and fluctuating engine instruments	Induction casting burning and/or burned through	Uncontrolled fire	Fire and feather procedure and alert crew
Black smoke	From accessory section	Variable oil pressure, high CAT and fire lights	Oil leak and oil fire	Uncontrolled fire	Fire and feather procedure and alert crew
Black smoke and orange flame	From accessory section	Variable fuel pressure, high CAT and fire lights	Gasoline leak and fire	Uncontrolled fire	Fire and feather procedure and alert crew

Figure 3-2A

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main cabin door. Leave open until smoke and/or fumes are eliminated.

2. If a trace of smoke and/or fumes remain in the cockpit area after the cabin is apparently clear, open the copilot's sliding window for final elimination.

NOTE

When the cabin door is unlatched, it will open approximately 2 inches. This is sufficient for average elimination of smoke and/or fumes. If more rapid elimination is required, the door may readily be held open (up to 6 inches) with the foot.

WARNING

If it is necessary to hold the cabin door open for smoke elimination, extreme caution should be exercised to avoid accidental falling from the aircraft. A parachute should be worn and the door pushed, with the foot, from a sitting position on the cabin floor.

LANDING EMERGENCIES.

Landing emergencies, generally, can be placed in two categories: minor, those which require only a slight change in the technique used for a normal landing with little possibility of more than minor damage to the aircraft; and major, those which require special technique and procedure with major damage to the aircraft possible if not probable.

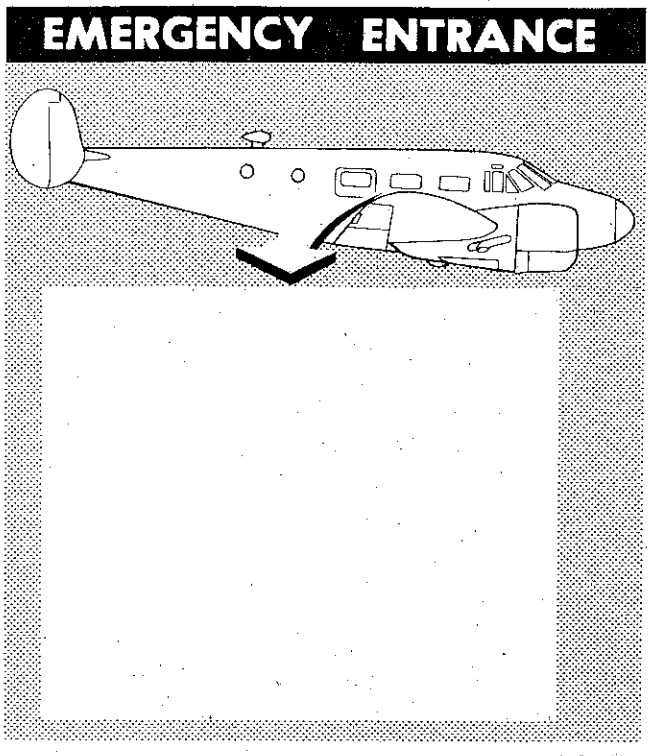

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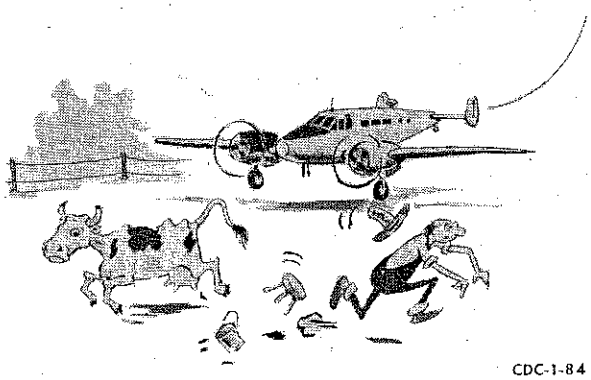
Figure 3-3



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LANDING WITH DEFLATED TIRES (MAIN GEAR).

If landing with both main landing gear tires flat is required, execute a minimum roll landing as outlined in Section II. After touch-down, allow the aircraft to roll to a stop without use of brakes if possible since brake application will tend to tear the tires from the wheels. Employ the same type of landing when one tire only is flat except that the initial touch-down should be made with the inflated tire. Also, touch-down should be on the edge of the runway near the inflated tire since, after both wheels are on the runway, the aircraft will tend to veer toward the side with the flat tire. Use brake on the inflated tire as necessary for directional control and to stop the landing roll as soon as possible.

LANDING WITH TAIL WHEEL TIRE DEFLATED.

When landing with the tail wheel tire flat, appproach for a normal landing. Touch-down on the main gear only and utilize slight forward elevator pressure to hold the tail off the runway as long as possible.

When the tail can no longer be kept up, brake the aircraft to a stop as rapidly as possible.

CAUTION

With the aircraft on the ground in a tail-high attitude and with forward elevator pressure applied, the tendency to nose over with a sudden application of brakes is greatly increased. Positive braking action is possible if application is smooth and gradual.

LANDING ON UNPREPARED RUNWAYS.

Landing on an unprepared runway can be made with a normal approach and landing if the surface is hard. If the surface is soft, there will be a tendency for the aircraft to nose over as the landing wheels sink into the surface and deceleration becomes rapid. Make an approach for a minimum roll landing. Land with power on and the aircraft in a tail-low attitude. As touch-down is made, apply full back pressure to the control column. Use no brakes. Air stream from the power that was being utilized at the time the landing was made will aid in keeping the tail down. Therefore,

this power should be continued on the landing roll and slowly decreased as the aircraft slows.

WHEELS UP LANDING.

In landing with both main wheels retracted, power should be utilized throughout the approach to assure landing on a suitable area. Proceed as follows:

In the traffic pattern
Generators — OFF.

Immediately before touch-down
Mixture levers — IDLE CUT-OFF.
Propellers — Feather.

All Ignition Switches — OFF.

Batteries — OFF.

Land with flaps full down in a slight nose high attitude but not fully stalled. With the landing gear retracted, the main landing gear wheels extend far enough out of the nacelles that they will support the aircraft. Brakes may be used for directional control or stopping. If only one landing gear extends, retract it and make a landing with both wheels up. If this cannot be done and it is necessary to land with only one extended, make an approach for a normal landing. Land with the wing on the side with the faulty landing gear slightly higher and utilize full aileron to hold it up as long as possible. As the wing finally touches, relax aileron, apply full back pressure and brake to a stop as rapidly as possible.

NOTE

On any landing where sufficient braking action is not available and ground-looping is not feasible, the aircraft may be stopped by retracting the landing gear during the landing roll.

EMERGENCY ENTRANCE.

If entrance to the aircraft through the cabin door is impossible or impractical, entrance may be gained through the "Emergency Rescue" area on the right side of the fuselage. The area to be broken through is indicated with yellow markings.

DITCHING.

In the event a forced landing on water becomes necessary, the following general instructions will apply; however, each organization will draw up a "Ditching Bill," giving ditching stations for crew and passengers and listing crew duties:

Send distress signal including time, position, altitude, ground speed, course and estimated position of landing.

Prepare the life raft which, if carried, is stowed in the lavatory compartment. It should be brought into the cabin near the exit and prepared for use. Do not inflate until the raft is outside the aircraft.

Safety belts should be secure but ready for instant removal.

Parachute harness should be removed.

In landing, the gear must be retracted and the flaps fully extended. The landing itself should be made with the aircraft in a nose-high attitude so that the tail strikes the water slightly first. If there is little or no wind, ditching will be made with as low IAS as possible. Waves are created and maintained by wind; consequently, landing should be made across the waves into the wind.

If a swell system is evident, the landing should be made parallel to the swells along a crest and, since swells do not necessarily run with the wind, as nearly into the wind as possible. If wind velocity is so great as to make this procedure impractical, landing may be made into the wind across the swells. If so, the touch-down should be made on the upslope of a swell near the top.

NOTE

Use of power is advisable. Even one engine will aid greatly in flattening the approach. For this reason, if it is certain land cannot be reached, land before fuel is exhausted.

BAIL OUT.

Decrease IAS to 100 mph (87 knots).

Jettison cabin door.

Maintain level flight until all occupants have left aircraft.

Head the aircraft toward the least inhabited area available.

Trim aircraft slightly nose down for straight flight.

Abandon the aircraft.

NOTE

For the purposes of mutual aid and survival, it is advisable to plan the bail out pattern so that after all passengers have bailed out, a 180 degree turn can be made permitting the pilot to abandon the aircraft in the same general area.

The safest procedure for leaving the aircraft is as follows:

Adjust parachute.
Kneel on the cabin floor facing the door.
Fall forward, head first, out the cabin door (in the same manner as turning a somersault).

WARNING

Do not jump from the cabin door. Leaving the aircraft in this manner, you may strike the tail surfaces.

FUEL SYSTEM.

If fuel pressure is lost, refer to Fuel Pressure Drop — Engine Operating Normally. To restart use the following procedure:

1. Throttle — 1/8 OPEN (on engine with no pressure) to prevent surging when the engine again begins to fire.

2. Engine Fuel Selector — FRONT TANK.
3. Fuel Booster — ON.
4. After pressure is regained, readjust power.
5. Fuel Booster — OFF. (If pressure fails with the fuel booster OFF, operate the engine with it on.)

If engine pressure cannot be regained, assume a broken line and complete the single engine procedure.

NOTE

After the engine is secure, check cross-feeding to determine that fuel can be utilized from the inoperative side. If the remaining engine stops when the cross-feed is turned ON, it would indicate the operating pump is sucking air and no fuel can be cross-fed in any manner.

FLAP SYSTEM.

In the event the electrical system fails to actuate the flaps, check the circuit breaker. If it is tripped, it should be reset and the electrical actuation attempted again. If the circuit breaker again trips, or if it was not tripped on the initial check, flaps should be operated by the emergency hand crank in the following manner:

Place flap switch in OFF position so that if the electrical circuit should become operative the flaps will not move from a set position.

NOTE

Prior to compliance with T. O. 1C-45H-203, the flap switch has three positions, "UP", "OFF" and "DOWN". After compliance with above T. O., the "OFF" position is removed.

Engage emergency hand crank (push in, toward pilot).

Turn crank (forward at top of stroke) to lower flaps; the opposite to raise flaps.

Approximately 30 turns are required for full flap travel. The flaps will lock in whatever position they are cranked to.

LANDING GEAR SYSTEM.

If the electrical system fails to operate the landing gear, BOTH the landing gear control circuit breaker on the circuit breaker panel and the landing gear circuit breaker on the pedestal should be checked. The landing gear may be extended manually; however, due to the weight of the gear and the inaccessibility of the hand crank, it is not recommended that you attempt to retract the gear manually unless there is someone available who can use both hands on the hand crank. Weight of the gear requires considerable force and is difficult to manage with one hand.

To extend the landing gear manually:

Pull out Landing Gear Control circuit breaker.

Place switch in DOWN position.

Raise landing gear clutch cover on floor board to the left of the pedestal.

Depress clutch pedal with toe and hold.

CDC-1-79

Allow gear to fall to trail position.

Engage emergency hand crank (move crank away from pilot) and turn (forward at top of stroke) until considerable resistance is encountered.

WARNING

The hand crank may cause serious injury to the operator if it is engaged, on gear extension, before the clutch has been released and the gear allowed to reach the limit of its free fall. The gear ratio in the emergency mechanism is such that during this period the crank spins quite rapidly and is all but impossible to hold.

Release clutch.

Since electrical power may be OFF, check gear down visually. (A small portion of each wheel is visible through the pilots' compartment windows by leaning well forward.)

Rock hand crank back and forth slightly until clutch pedal is all the way back against the floor boards.

The landing gear switch circuit breaker should be pulled out and the switch placed in the DOWN position as a safety measure. Be certain the clutch is full back against the floor board to insure locking the gear in position. If the electrical system has been turned off, be sure the landing gear switch is left in the DOWN position so the gear will not accidentally retract if the electrical system is turned ON.

ELECTRICAL POWER SYSTEM.

In the event a generator becomes inoperative:

Reset circuit breakers and overvoltage relay.

Check voltmeter and loadmeter for output.

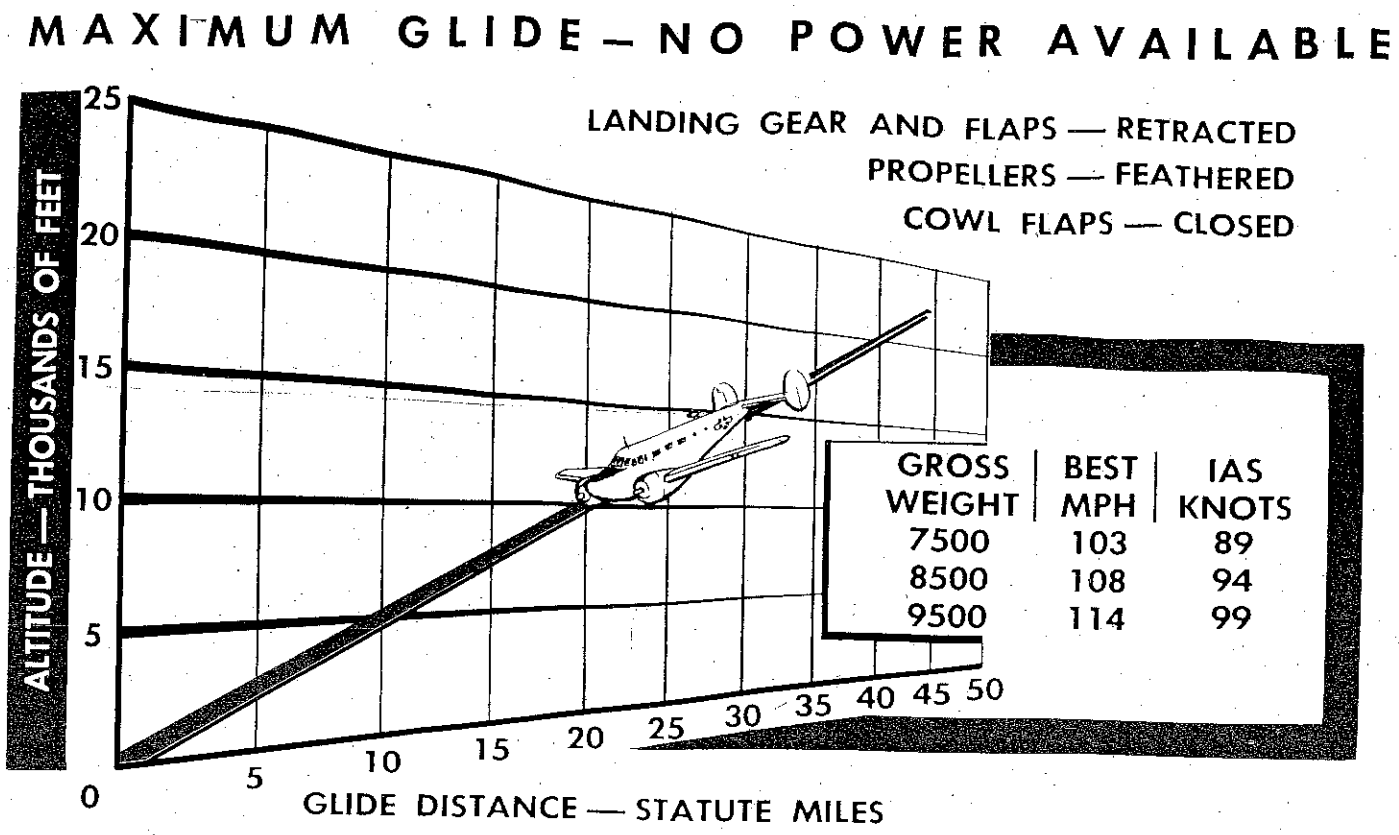

Figure 3-4

If generator fails to become operative, or again becomes inoperative, disconnect from the system.

On this aircraft, with all electrical equipment operating, (with the exception of the landing gear) when the landing gear system is operated, the load momentarily exceeds the capacity of one generator. Therefore, the loss of one generator, either through malfunction or as a result of single engine operation, does not present a problem.

The system is so designed that as a generator becomes inoperative it is automatically disconnected from the system, but as an added precaution the switch for that generator should be turned OFF.

All electrically powered equipment, not required for safe flight under the existing conditions, should be off.

NOTE

DELETED

A study of the Electrical Load Analysis in Section VII will show the load requirements of all operational and navigational equipment.

ELECTRICAL SYSTEM TROUBLE SHOOTING TABLE.

The majority of electrical system failures which occur, or which may occur in flight, can in some instances be corrected and the system involved be brought back into operation. The following table (figure 3-4A Sheets 1 and 2) was prepared with that thought in mind. The data which is included and the manner in which it is presented is intended to furnish flight crews the necessary information which will be needed to detect a system malfunction, correct it before major damage to the system wiring or components has occurred and then, if possible, bring the system back into operation. The following table is provided for C-45H aircraft which use two type M-3 generators with rated output of 50 amperes or C-45H aircraft which are equipped with two type 30E16-1-A generators with rated output of 100 amperes after compliance with T. O. 1C-45H-201. This table lists the most common causes of electrical system malfunction, two visual indication columns are provided: one with generator switches "ON" and the other with generator switches "OFF". Two "action columns" are provided; one "Immediate Action," stipulates procedures to be followed immediately upon noting a system malfunction. The "Corrective Action" column outlines the procedure to be followed in flight to bring the system back into operation so that the mission may be continued or specifies the corrective action limits. In come cases no corrective action can be taken until ground facilities are available.

CAUSES OF DC ELECTRICAL SYSTEMS FAILURE		VISUAL INDICATION OF ELECTRICAL SYSTEMS MALFUNCTION WITH GENERATOR SWITCHES "ON"				VISUAL INDICATION GENERATOR	
Item No.		Generator Voltmeter Failure	Generator Ammeter Failure	Other Voltmeter	Other Ammeter	Generator Voltmeter Failure	Generator Ammeter Failure
1.	OPEN GENERATOR ARM WINDINGS, BROKEN BRUSHES, GENERATOR SHAFT SHEAR OR BEARING FAILURE.	Zero Reading On Failed Generator	Zero Reading	Normal Bus Voltage (28.5) On Good Generator	Above Normal	Zero Reading	Zero Reading
2.	OPEN GENERATOR FIELD CIRCUIT, OPEN VOLTAGE REGULATOR.	Zero Reading	Zero Reading	Normal Bus Voltage (28.5)	Above Normal	Zero Reading	Zero Reading
3.	OVERVOLTAGE.	High Momentarily Then Zero Reading	High Momentarily Then Zero Reading	High Momentarily Then Normal	High Above Normal	Zero Reading	Zero Reading
4.	IMPROPER PARALLELING DUE TO OVERVOLTAGE.	Normal or Above (28.5)	Above Normal	Normal or Above (28.5)	Below Normal	Normal or Above (28.5)	Zero Reading
5.	LOW VOLTAGE, IMPROPER PARALLELING, HIGH RESISTANCE FIELD CIRCUIT FAULT. OPEN REVERSE CURRENT COIL CIRCUIT.	Normal or Below (28.5)	Low or Zero Reading	Normal or Below	Above Normal	Normal or Below (28.5)	Zero Reading
6.	ELECTRICAL SYSTEM IS NOT WARMED UP.	Below Normal	Below Normal	Below Normal	Above Normal	Below Normal	Zero Reading
7.	GROUND FAULT ON GENERATOR LEADS.	Below Normal	Zero Reading	Normal	High Above Normal	Below Normal	Zero Reading
8.	GROUND FAULT ON GENERATOR LEADS WITH WELDED REVERSE CURRENT RELAY.	Below Normal	Zero Reading	Low	High Above Normal	Below Normal	Low Off Scale
9.	GROUND FAULT ON MAIN BUS.	Low	High Above Normal	Below Normal	High Above Normal	Normal	Zero Reading

NOTES: (1) Generator Switch Controls, 3 components; Reverse Current Relay, Overvoltage Relay, and Generator Field Relay Re-Set Coil.
a. Generator switch in "ON" position closes circuit to reverse current relay.
b. Generator switch in "OFF" position disconnects circuit to reverse current relay.
c. Overvoltage light — Generator light will come on only when overvoltage condition occurs. Light will turn off when generator switch is placed in "re-set" position, provided generator field relay closes.
(2) SAFETY MEASURES IN CONNECTION WITH ELECTRICAL SYSTEM.
a. In event open circuit breaker is found in any generator leads, do not reset prior to determining cause of failure. For example, a ground fault which, if re-energized, could cause a serious fire.
b. Make certain electrical system (reverse current relay, voltage regulator and generator) is functional after any inspection or overhaul which may affect the electrical system.

Figure 3-4A. (Sheet 1 of 2)

WITH FAILED SWITCH "OFF"		Immediate Action	Corrective Action
Other Voltmeter	Other Ammeter		
Normal Bus Voltage (28.5)	Above Normal	Leave failed generator switch in "OFF" position. If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and nonessential equipment turned "OFF."	Leave good generator on system, turn off all nonessential loads to reduce load to below the 50 ampere rating. Fire, if going to occur, will normally be in evidence 1 to 10 minutes after generator failure. It should be noted that fire is a rare occurrence.
Normal Bus Voltage (28.5)	Above Normal	Leave generator switch in "OFF" position. If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and nonessential equipment turned off.	Inspect for open generator field or defective voltage regulator. If defect can be corrected, reclose generator switch to "ON." Never remove voltage regulator except in emergency without shutting down engine, and do not interchange a voltage regulator from a faulty generator with a regulator of a good generator in flight.
Normal	Above Normal	Leave generator switch in "OFF" position. If any generator failures occur, the ammeter of the generators remaining on the bus should be immediately checked for overload and nonessential equipment turned off, if necessary.	Leave generator switch off. Inspect voltage regulator for loose or shorted wiring. Attempt to clear fault and return generator switch to ON position. Watch closely for evidence of further overvoltage indication. If overvoltage still prevails, return generator switch to OFF position.
Normal	Above Normal	Leave generator switch "OFF." Check other generator ammeter to see that load is approximately twice normal indicated output or total load of system. When faulty generator is taken off circuit system will become stable.	If possible, check voltage regulator bases for short circuit on equalizer leads (d and k terminals). If equalizer leads can be cleared, reclose generator switches to "ON" position. If equalizer lead fault cannot be located or cleared, do not make more than one attempt to place generator on bus unless additional electrical power is absolutely needed.
Normal	Above Normal	Leave generator switch "OFF." If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and non-essential equipment turned off, if necessary.	Increase voltage of failed generator to normal by turning the voltage regulator rheostat clockwise. Reclose generator switch to "ON" position. If generator takes load and is absolutely needed, leave switch "ON." Do not, under any circumstances, interchange a voltage regulator from a faulty generator with a regulator of a good generator in flight. Also, do not attempt to rebalance electrical loads by ammeter indicator unless electrical system has been in operation for over 15 minutes (for warm-up).
Above Normal	Above Normal	None	System is not warmed up. Do not attempt to rebalance electrical loads by ammeter indicator unless electrical system has been in operation for over 15 minutes.
Normal	Above Normal	Leave generator switch "OFF."	Inspect generator leads at control box. If leads can be cleared and are serviceable, generator switch may be reclosed to "ON" position.
Below Normal	High Above Normal	Turn battery and generator switches "OFF." Remove voltage regulator. Generator with faulted leads will have a lower voltage than other generator.	If ground fault on main bus can be closed, generator leads from bus or circuit breaker. Reclose good generator and battery switches to "ON" position, if fault is cleared or circuit breaker is open.
Low	High Above Normal	Turn "OFF" all battery and generator switches. Inspect available sections of main bus for ground fault.	If ground fault on main bus can be cleared, reclose generator and battery switches to "ON" position.

c. When checking electrical system, turn off all electrical equipment (battery, radio, etc.) which would be affected by overvoltage. Inverters will not be adversely affected if over-voltage periods are short and kept as low as possible during checkout. Every effort should be made to not exceed 30 volts.
d. In event an electrical malfunction trips more than one, or all generators, turn off bus, turn off battery switch immediately, and all nonessential electrical loads. Reclose battery switch, 're-set' generator circuit breakers, check voltages, place one good generator only on bus, turn 'OFF' battery switch. Then check other generator and attempt to return electrical system to normal. Reclose battery switch.
e. When checking electrical system, turn off all electrical equipment (battery, radio, etc.) which would be affected by overvoltage. Inverters will not be adversely affected if overvoltage periods are short and kept as low as possible during checkout. (Every effort should be made to not exceed 30 volts). Check should also be made to assure overvoltage relay does not trip below 31 volts.

Figure 3–4A. (Sheet 2 of 2)