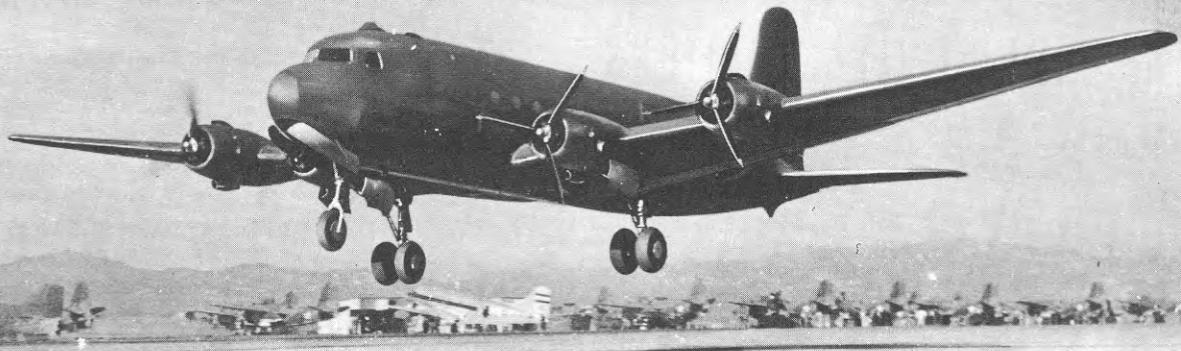


emergency procedures**section
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INTRODUCTION.

This section contains what are considered the best procedures for coping with various emergencies that may be encountered during takeoff, flight, and landing. It is realized that every emergency presents a different problem; however, a thorough knowledge of these procedures will enable a pilot to better cope with the emergencies he may encounter. After determining that an emergency exists, the pilot will immediately establish communication with the ground station with which he is in contact at the time. There has been a tendency in the past to minimize certain disorders that could become serious. This practice is not consistent with safety since there may be insufficient time later to alert the agencies that can help. Once an emergency call has been channeled to Air Rescue Service and other agencies, a constant check on the progress of the flight is maintained. Include a complete description of your trouble in the original message. This enables rescue agencies to make early preparations and computations in connection with their responsibilities. Emphasis should be placed on accurate position reporting. Keep your ground station personnel notified

at all times of any changes or developments in the emergency, and inform them of any action taken.

ENGINE FAILURE.

Engine failure during takeoff can be recognized by the control force necessary to maintain directional control. Engine failure in flight can be determined by observing cylinder head temperature, oil pressure, fuel flow, manifold pressure, and rpm indications. When engine failure is encountered, maintain proper airspeed and directional control, and perform the steps outlined in engine failure during takeoff, this section. See Appendix for three-engine performance data. Refer to figure 3-2 for a typical one- or two-engines inoperative landing and go-around.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS.

Only at takeoff power and slow speeds does the aircraft require a great amount of pilot force to compensate for the turning action caused by engine failure. Very little trim is required at cruise configuration. As airspeed

decreases, more rudder deflection is necessary to counteract the unbalanced thrust. Banking away from the failed engine reduces rudder deflection. Minimum control airspeed in flight with one engine out and its propeller windmilling, maximum power applied to the remaining engines, landing gear retracted, 15-degree wing flaps with a 5-degree bank angle away from the failed engine, is 83 knots (96 mph) IAS. Recommended minimum one engine out operation is never less than 110 per cent of the minimum control speed (92 knots [106 mph] IAS), or 115 per cent of power-off stall speed (clean configuration) for the given gross weight, whichever airspeed is the greatest (figure 3-1). Above 60,000 pounds gross weight, the zero thrust stall speed is greater than the minimum control speed, and therefore must be observed as the minimum value of the minimum control speed.

THREE-ENGINE CLIMB.

Take off at V_2 speed. More control displacement is required at takeoff due to loss of stabilizing effect of the landing gear. For best control of the aircraft and ability to maneuver, use up to three degrees of bank away from the failed engine and three degrees of yaw toward the failed engine. This position can best be described as a slight forward slip away from the failed engine. Indications of the amount of bank and yaw on the turn-and-slip indicator are: needle centered and the ball displacement about one fourth width away from the failed engine. Use of this position will result in minimum control displacement and will minimize rudder buffet. Control pressures required with one engine out will increase as speed increases; also control pressures required for a windmilling propeller will be greater than those required for a feathered propeller. Begin landing gear retraction when the aircraft is definitely airborne with a positive rate of climb. Maintain V_2 speed until obstacles have been cleared. During the initial climb, no attempt should be made to trim out the control forces, as they are sufficiently light to hold for the brief period of time required at the lower airspeed. Full attention should be devoted to holding the correct attitude, airspeed, and heading. To reduce drag, feather the propeller and close the cowl flaps of the inoperative engine as soon as possible. When the obstacles have been cleared, allow the aircraft to accelerate to the flap retraction speed. For every degree of flap retraction from the takeoff setting, an airspeed increase of approximately one knot is required to maintain a safe flap retraction speed margin above V_2 for that flap deflection angle. Under conditions of reduced acceleration, it may become necessary to maintain a slight amount of back elevator pressure to increase the angle of attack. This

CHECK THIS
CHART

SAFE THREE-ENGINE CLIMB-OUT AIRSPEEDS

BASED ON FLIGHT TEST DATA
AS OF - MAY 18, 1946

CONDITIONS

1. Wing Flaps — 15 Degrees
2. Gear Down
3. Inoperative Propeller Windmilling
4. 110% Minimum Control Speed
Or 115% Power Off Stall Speed
5. Maximum Power

GROSS WEIGHT (POUNDS)	IAS KNOTS	IAS MPH
50,000	93	107
60,000	93	107
62,000	94	108
65,000	97	112
73,000	102	117

WARNING

Minimum control speed at sea level in flight is 83 knots (96 mph), and it is recommended for one engine out operation that flight speed never be less than 110 per cent Minimum Control Speed or 115 per cent power off stall speed, whichever is higher.

Figure 3-1

ONE OR TWO ENGINES INOPERATIVE

WARNING:

WITH THE LIMITED POWER AVAILABLE, A SUCCESSFUL TWO ENGINE GO-AROUND IS CRITICALLY DEPENDENT UPON AIRCRAFT GROSS WEIGHT, EXISTING AIRSPEED, DEGREE OF FLAPS EXTENSION, AND THE ALTITUDE AT WHICH THE GO-AROUND IS INITIATED.

LAND: FLAPS AS REQUIRED. REDUCE AIRSPEED TO PRESCRIBED THRESHOLD SPEED.

GO-AROUND: COMMAND "GO-AROUND MAX POWER". PROPELLER LEVERS FULL FORWARD. THROTTLES MAX POWER. BEST ANGLE OF CLIMB SPEED. WING FLAPS 20 DEGREES. LANDING GEAR UP.

ACCELERATE TO FLAP RETRACTION AIRSPEED. RAISE FLAPS IN 5 DEGREE INCREMENTS. ACCELERATE TO NORMAL CLIMB. METO POWER AT SAFE MANEUVERING ALTITUDE.

LAND: FLAPS AS REQUIRED. REDUCE AIRSPEED TO PRESCRIBED THRESHOLD SPEED.

ACCELERATE TO FLAP RETRACTION AIRSPEED. RAISE FLAPS IN 5 DEGREE INCREMENTS. ACCELERATE TO NORMAL CLIMB. METO POWER AT SAFE MANEUVERING ALTITUDE. SEE WARNING.

GO-AROUND: COMMAND "GO-AROUND." PROPS FULL INC. THROTTLES MAX POWER. FLAPS 20 DEGREES. BEST ANGLE OF CLIMB SPEED. LANDING GEAR UP.

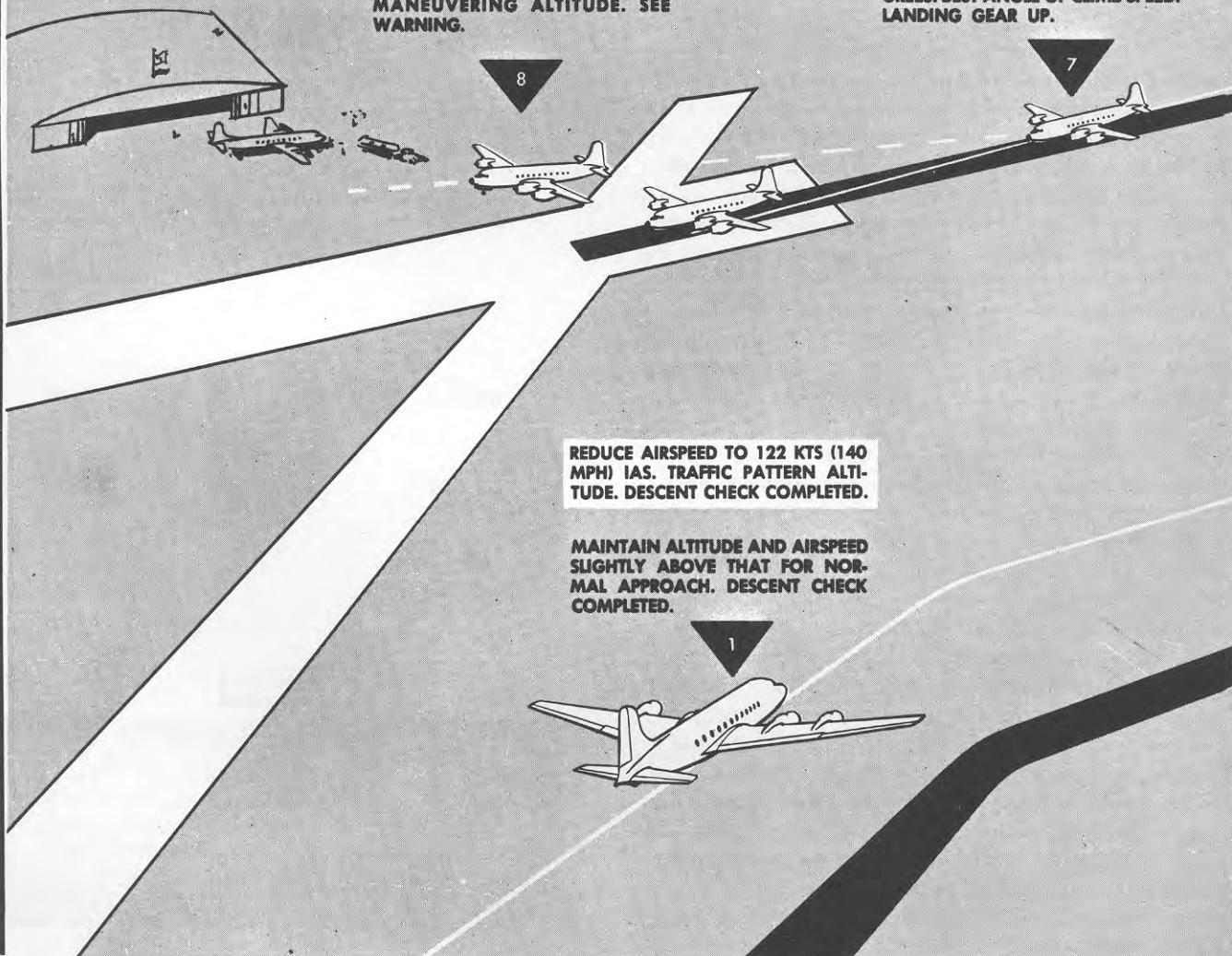


Figure 3-2 (Sheet 1 of 2)

LANDING AND GO-AROUND PATTERN — Typical

WING FLAPS 20 DEGREES MAX.
MAINTAIN AIRSPEED AT OR ABOVE
MINIMUM 3 ENGINE CLIMB SPEED.
DECISION TO LAND OR GO-
AROUND.

MAINTAIN AIRSPEED AT OR ABOVE
MINIMUM 2 ENGINE CLIMB SPEED.
DECISION TO LAND OR GO-
AROUND.

RPM 2300. WING FLAPS 10 DE-
GREES. TRAFFIC PATTERN ALTITUDE.
INITIATE BEFORE LANDING CHECK.

RPM 2550. MAINTAIN ALTITUDE.
INITIATE BEFORE LANDING CHECK.

ALTITUDE NOT BELOW 600 FT.

ALTITUDE NOT BELOW 600 FT. RPM
2700. LANDING GEAR DOWN
WHEN CERTAIN RUNWAY CAN BE
REACHED. BEFORE LANDING CHECK
COMPLETED.

CHECK LANDING GEAR DOWN.
AIRSPEED 122 KTS (140 MPH) IAS.

WING FLAPS 10 DEGREES. 122 KTS
(140 MPH) IAS MINIMUM.



ONE ENGINE INOPERATIVE
TWO ENGINES INOPERATIVE

Note:

Pattern shown is typical (gross weight 63,500) and must be modified to comply with local field conditions and for variances in gross weight. For 2 or 3 engine performance data and other non-standard conditions, refer to the appendix.

Figure 3-2 (Sheet 2 of 2)

will prevent settling as the flaps are retracted. After flap retraction, the aircraft should be flown with the wings level and with zero yaw. When climb speed is reached, reduce power to normal rated and maintain until sufficient altitude is attained to maneuver the aircraft safely. At this time, trim out the control forces; reduce to climb power when there is adequate terrain clearance.

ENGINE FAILURE DURING TAKEOFF.

Before each takeoff, the critical engine failure speed for the takeoff configuration must be determined by referring to the Appendix.

Aborted Takeoff.

Refer to ABORT, this section.

Continued Takeoff.

During takeoff, when critical engine failure speed has been exceeded, failure of an outboard engine near minimum control speed requires nearly full rudder displacement and approximately one half aileron displacement to maintain directional control, whereas failure of an inboard engine requires one half of these control deflections. Under normal wind conditions, nosewheel steering is not required to maintain directional control, but it is required with a crosswind from the same side as the failed engine. In this case, apply down elevator to increase nose traction. As speed increases during the period of three-engine acceleration, less control displacement is required. Keep the nosewheel on the ground until V_2 speed is reached, with slight up elevator being applied approximately 5 knots below takeoff speed; continue takeoff as follows:

1. Takeoff and climb at V_2 speed.
2. Raise the landing gear after the aircraft is safely airborne.

3. Feather the propeller of the failed engine immediately.
4. After obstacles are cleared, retract wing flaps at appropriate airspeed and accelerate to proper climb speed.
5. Throttle — Close.
6. Mixture — IDLE CUTOFF.
7. Fire extinguisher selector handle — Pull out.
8. If fire exists; either CO_2 handle — Pull out.
9. Cowl flaps — TRAIL.
10. Booster pumps — OFF.
11. Smoke or oxygen masks — On.
12. Vacuum selector — As required.
13. Ignition switch — OFF.
14. Generator — OFF.
15. Failed engine tank selector lever — OFF.
16. Crossfeeds — As required.
17. Prop anti-icing — As required.
18. Cowl flaps failed engine — CLOSED.

Note

In case of fire while the propeller anti-icing system is in operation, the alcohol to the affected engine should be shut off. This will also shut off the alcohol supply to the opposite engine. When it is determined that the fire is extinguished, the anti-icing rheostat switch may be turned ON to furnish alcohol to the unaffected engine propeller, if necessary.

ENGINE FAILURE DURING FLIGHT.

If an engine fails during flight, perform the following steps:

1. Throttle — CLOSE (not required in case of fire).
2. Feathering button — Push.
3. Mixture — IDLE CUTOFF.
4. Fire extinguisher selector handle — Pull out.
5. If fire exists; either CO₂ handle — Pull out.
6. Cowl flaps — TRAIL.
7. Booster pumps — OFF.
8. Smoke or oxygen masks — On.
9. Vacuum selector — As required.
10. Ignition switch — OFF.
11. Generator switch — OFF.
12. Failed engine tank selector lever — OFF.
13. Crossfeeds — As required.
14. Prop anti-icing — As required.
15. Cowl flaps failed engine — CLOSED.

Note

Attempt to discover the cause of engine failure. Check the fuel and oil quantity indicators, fuel valve controls, fuses, circuit breakers, lines, and wiring.

Note

If it is impossible to maintain safe altitude for minimum terrain clearance, lighten the load by jettisoning all non-essential equipment and cargo.

FAILURE OF TWO ENGINES.

Two-engine operation is critical at gross weights exceeding 65,000 pounds at 5000 feet msl using METO power. See Appendix for two-engine performance.

Note

Above 5000 feet at gross weights exceeding 65,000 pounds, it will not be possible to maintain altitude with two engines out. However, the two operating engines allow a controlled descent to the critical altitude.

Jettison all cargo, except emergency equipment, as soon as possible after isolating the two failed engines.

Prepare for an emergency landing or ditching. Land as soon as practicable.

FAILURE OF THREE ENGINES.

It is impossible to maintain altitude at any gross weight with three engines inoperative.

ENGINE RESTART DURING FLIGHT.

If it becomes necessary to unfeather the propeller after an engine shutdown in flight, perform the following steps.

WARNING

Do not restart an engine that has been shut down because of fire or a broken fuel line.

1. Fire extinguisher selector valve handle — Push.
2. Fuel tank selector lever — As required.
3. Crossfeed selector lever — As required.
4. Propeller lever — DEC. RPM.
5. Throttle — 1/4 open.
6. Reduce airspeed to 122 knots (140 mph) IAS — Maximum.
7. Turn engine minimum eight blades with starter.
8. Ignition switch — BOTH.
9. Booster pumps — LOW.
10. Propeller feathering button — Depress and hold until propeller windmills at 500 to 800 rpm.
11. Mixture lever — AUTO-RICH (at minimum governing rpm of 1200).
12. Temperatures and pressures — Checked.
13. Rpm — 1500 (warm engine gradually).
14. Cowl flap lever — As required.
15. Generator switch — ON.
16. Advance rpm and manifold pressure to desired operating settings.

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, be prepared to direct fire extinguishing agent to the affected engine, and shut down the affected engine. *Do not take off.* Investigate the cause of the malfunction and correct.

During Flight.

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

WARNING

Whenever fuel pressure drops and the engine continues operating normally, the first concern of the crew must be to guard against the outbreak of an engine fire. The greatest danger lies in the fact that the crew develops a false sense of security because no fire exists at the time that the fuel pressure drop is noticed nor after several hours of flight. However, when the throttle is retarded (as in preparation for landing), an engine fire develops and the results are usually disastrous. What has happened is that a fuel leak existed, but the cooling and dispersing effect of the airflow through the engine nacelle at cruising airspeed has prevented the start of a fire. When the throttle was retarded, the airspeed dropped and the airflow was reduced sufficiently to permit ignition of the leaking fuel. Any change in the airflow pattern, such as feathering the propeller or entering a climb, can start a fire if a fuel leak exists. Increasing the power is less likely to start a fire since airspeed will be increased, but even here, there is a possibility of fire since the exhaust heat and flame pattern may change sufficiently to outweigh the increase in cooling airflow. Accordingly, it must be the objective of the crew to eliminate the fuel before any change is made to the airflow or exhaust pattern. The most effective means of accomplishing this is by moving the mixture control lever to IDLE CUT OFF

before any throttle reduction, propeller feathering, or any engine shut down procedure is initiated. An additional advantage of moving the mixture control lever to IDLE CUT OFF is that it provides the most rapid means of eliminating exhaust stack flames and reducing exhaust heat.

1. *Shut down the engine immediately by means of the mixture control lever.* Do this if power is not necessary to sustain flight or to reach a safe destination.
2. *Keep the affected engine in operation at or above cruising airspeed while maintaining a 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, shut down the affected engine completely (by means of the mixture control lever — not by retarding the throttles) 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.
3. *Continue operating the engine normally.* This may be done if it can be reasonably ascertained that the indicated fuel pressure drop has not resulted from a fuel leak.

Note

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

LANDING WITH ONE ENGINE INOPERATIVE.

Use the following procedure during a landing with one engine inoperative:

1. Make a normal approach and landing. Upon entering traffic pattern, set rpm at 2300.
2. Do not extend the wing flaps beyond 20 degrees until assured that the runway can be reached.

LANDING WITH TWO ENGINES INOPERATIVE.

Since two-engine performance is limited, any power that is available from the failing engines will increase the safety factor. Perform the landing operation as follows:

1. Upon entering traffic pattern, set rpm at 2550.

- 1A. Wing flaps 10 degrees (on the base leg). 122 knots (140 mph) IAS minimum.
- 2. On the final approach 122 knots (140 mph) IAS minimum, when it is certain that the field can be reached, lower the landing gear, and advance rpm to 2700.
- 3. Wing flaps - As required, when positive the runway can be reached.

If both inboard engines are inoperative, the vacuum flight instruments and the two engine-driven hydraulic pumps located on the inboard engines will be inoperative (on R5D aircraft, the generators also are inoperative). If IFR conditions exist, an effort should be made to permit the propeller of either of the inoperative engines to windmill, providing vacuum flight instruments with pressure. If both inboard propellers must be feathered, see aircraft systems, emergency operation, this section, for operation of the wing flaps, landing gear, and hydraulic brakes.

GO-AROUND WITH ONE OR TWO ENGINES INOPERATIVE.

The sooner the decision to go-around is made, the greater the margin of safety. When considering the possibilities for go-around, altitude, airspeed, gross weight, aircraft configuration, wind conditions, runway facilities, and visibility should always be considered. If the pilot deems it necessary to refuse a landing, he will accomplish the following:

1. Give the command, "go-around," to the copilot and engineer.
2. Propeller levers – INC RPM (full forward).
3. Throttles – Open to maximum power.
4. Direct crew engineer to raise flaps to 20 degrees.
5. Attain speed for best angle of climb for obstacle clearance (takeoff speed).
6. Landing gear – UP.
7. After obstacles have been cleared, maintain maximum power and increase airspeed. At wing flap retraction airspeed, raise wing flaps to 0 degrees in 5-degree increments, and increase airspeed for normal climb.
8. Proceed with normal climb until reaching safe altitude to maneuver, then reduce to METO power.

Note

To maintain a constant heading at 110% of the minimum control speed with two engines on one side operating, as power is applied for the go-around, will require nearly full rudder, one half to two thirds aileron, and a 5-degree bank angle toward the two operating engines. The aircraft must be flown straight directionally, but with a bank angle of approximately 5 degrees, in order to attain the attitude required for both acceleration and climb performance.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE.

Engine failures may be simulated for practice. To simulate a feathered-propeller condition, retard the throttle or throttles of the selected engines to approximately 15 inches Hg (1500 rpm). The procedure on encountering engine failure may be called out without actually performing the steps.

CAUTION

When maneuvering with low power or during descents with low power, it is important to cushion the high inertia loads on the master bearings which occur with high rpm and low manifold pressure. As a rule of thumb, each 100 rpm requires at least 1 inch Hg manifold pressure. Use high rpm and low manifold pressure ranges only when necessary.

PROPELLER FAILURE.

PROPELLER OVERSPEEDING.

If an engine seriously tends to overspeed (runaway propeller), indicating that the propeller governor is not functioning to reduce rpm, proceed as follows:

CAUTION

Do not confuse momentary surging with actual overspeeding.

ON TAKEOFF.

If propeller overspeeds before critical engine failure speed is attained, close all throttles and stop.

If propeller overspeeds after critical engine failure speed is attained, continue the takeoff and accomplish the following:

1. Close the respective throttle.
2. Feather the runaway propeller.
3. Place the mixture lever of the overspeeding engine in IDLE CUTOFF.
4. Perform all steps under procedure on encountering engine failure.
5. Climb to a safe altitude and return to the field.

Note

The following steps may be used as an aid in reducing rpm during the early stages of propeller overspeeding: (1) retard throttle; (2) retard propeller lever; (3) alternately depress and pull out feathering button.

DURING CRUISE FLIGHT.

1. Reduce airspeed to less than 120 knots (140 mph) IAS as rapidly as possible. The aircraft may also be pulled up to hasten the reduction of forward speed.
2. Reduce power and attempt to control rpm by prop lever or feather button.
3. Place the mixture lever of the runaway propeller in IDLE CUTOFF.
4. Feather the runaway propeller.
5. Speed may be resumed after the propeller becomes motionless.
6. Complete feathering procedure.
7. When overspeeding occurs, the following information should be noted in AFTO Form 781 and reported to maintenance personnel: the maximum rpm and manifold pressure that was obtained during flight, duration in minutes of overspeed, and the reason, if known.

Note

Propeller windmilling characteristics are a function of airspeed; therefore, if unable to feather the propeller, maintain reduced airspeed.

FIRE.

Any time a fire develops in flight, a decision to accomplish an emergency descent should be made immediately.

ENGINE FIRE ON GROUND.

If an engine fire occurs on the ground, shut down the engine and investigate. If an induction fire occurs during starting, perform the following steps in the order listed:

1. Continue cranking.
2. Discontinue prime.
3. Mixture lever — IDLE CUTOFF.
4. Throttle — OPEN.
5. If the fire continues to burn, signal the ground crew to use the portable fire extinguishing equipment and notify the tower. If away from flight line or the fire continues, pull the fire extinguisher selector valve handle for the affected engine, then pull the CO₂ cylinder discharge handle.
6. Ignition switch — OFF.
7. Shut down the engine completely.
8. Shut down the other engines, if operating.
9. Battery switch — OFF.
10. APP — OFF.
11. Do not attempt to restart the engine after discharging CO₂.
12. Notify the crew and passengers to leave the aircraft.

ENGINE FIRE IN FLIGHT.

In many instances, hazardous conditions have resulted from flight crews being unable to identify accurately engine smoke patterns and to apply prompt remedial action for the specific cause. If a crew member notices smoke coming from one of the engines, the smoke and flame identification chart (figure 3-3) should be used to identify the cause. Upon identification, the remedy listed for this specific cause should be put into effect immediately.

WARNING

Fire extinguisher selector handles must be pushed back in before a charge is released to another compartment or a split charge will result.

FUSELAGE FIRE.

In the event of fuselage fire, proceed as follows:

1. Close all hatches, doors, and ventilating ducts.
2. Smoke or oxygen mask — On and set at 100%.
3. Attack fire immediately with all available fire extinguishers.

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB), or decomposition products, should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken, including the use of oxygen, when available.

LOWER CARGO COMPARTMENT FIRE.

If a lower cargo compartment fire occurs, perform the following steps:

1. APP — OFF.
2. Doors and hatches — Closed.
3. Applicable cargo compartment selector handle — Pull out.
4. Both CO₂ cylinder discharge handles — Pull out.
5. Smoke or oxygen masks — On and set at 100%.

NOSE SECTION FIRE.

In the event of a nose section fire, proceed as follows:

1. Cockpit heater switch — OFF.
2. Blower — OFF (if on the ground).
3. APS-42 — OFF.
4. Footwarmer and defroster — CLOSE.
5. NOSE SECT selector handle — Pull out.
6. Either CO₂ cylinder discharge handle — Pull out.
7. Gear — DN (provided field can be reached).
8. Smoke or oxygen masks — On and set at 100%.

WING FIRE.

If a wing fire occurs during flight, attempt to control it as follows:

1. Begin emergency descent immediately.
2. Alert the crew for possible bailout or ditching.
3. Attempt to extinguish the fire by sideslipping the aircraft away from the fire.
4. Make an emergency landing or abandon the aircraft.

SMOKE AND FLAME IDENTIFICATION CHART					
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, after fire or backfire from lean mixture and/or carburetor 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 stock 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	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

ENGINE FIRE IN FLIGHT.

In many instances, hazardous conditions have resulted from flight crews being unable to identify accurately engine smoke patterns and to apply prompt remedial action for the specific cause. If a crew member notices smoke coming from one of the engines, the smoke and flame identification chart (figure 3-3) should be used to identify the cause. Upon identification, the remedy listed for this specific cause should be put into effect immediately.

WARNING

Fire extinguisher selector handles must be pushed back in before a charge is released to another compartment or a split charge will result.

FUSELAGE FIRE.

In the event of fuselage fire, proceed as follows:

1. Close all hatches, doors, and ventilating ducts.
2. Smoke or oxygen mask — On and set at 100%.
3. Attack fire immediately with all available fire extinguishers.

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB), or decomposition products, should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken, including the use of oxygen, when available.

LOWER CARGO COMPARTMENT FIRE.

If a lower cargo compartment fire occurs, perform the following steps:

1. APP — OFF.
2. Doors and hatches — Closed.
3. Applicable cargo compartment selector handle — Pull out.
4. Both CO₂ cylinder discharge handles — Pull out.
5. Smoke or oxygen masks — On and set at 100%.

NOSE SECTION FIRE.

In the event of a nose section fire, proceed as follows:

1. Cockpit heater switch — OFF.
2. Blower — OFF (if on the ground).
3. APS-42 — OFF.
4. Footwarmer and defroster — CLOSE.
5. NOSE SECT selector handle — Pull out.
6. Either CO₂ cylinder discharge handle — Pull out.
7. Gear — DN (provided field can be reached).
8. Smoke or oxygen masks — On and set at 100%.

WING FIRE.

If a wing fire occurs during flight, attempt to control it as follows:

1. Begin emergency descent immediately.
2. Alert the crew for possible bailout or ditching.
3. Attempt to extinguish the fire by sideslipping the aircraft away from the fire.
4. Make an emergency landing or abandon the aircraft.

ELECTRICAL FIRE.

If the fire or smoke is definitely identified as being of electrical origin, but the source of the electrical fire is not determined, proceed as follows:

1. Alert the crew.
2. Generator and field relay switches — OFF.
3. Battery switch — OFF.
4. APP — OFF.
5. Smoke mask or oxygen mask — On and set at 100%.
6. Don asbestos gloves.
7. Use hand fire extinguisher to combat fire.
8. All circuit breakers — Tripped.
9. Remove voltage regulators, if necessary (C-54).
10. When the source of smoke or fire has been found and the fire extinguished, leave the involved circuit inoperative and restore power to the remaining circuits.
11. Battery switch — ON.
12. Generator switches (one at a time) — ON.
13. Necessary circuit breakers (one at a time) — ON.

Note

Watch for recurrence of smoke or fire while resetting circuit breakers.

CABIN HEATER FIRE.

In case of cabin heater fire, proceed as follows:

1. Cabin heater control rheostat and emergency switches — OFF.
2. Smoke mask or oxygen mask — On and set at 100%.
3. If smoke is emanating from the cabin heater vent, insert the nozzle of a CO₂ hand fire extinguisher in the heater trap door and discharge the CO₂.
4. If smoke is emanating from around the heater duct, expose the burning material and extinguish the fire with CO₂.

AUXILIARY POWER PLANT FIRE (CABIN MOUNTED).

If a fire occurs in the auxiliary power plant during its operation, proceed as follows:

1. Alert the crew.
2. Battery and generator switches — OFF.
3. APP ignition switch — OFF.
4. Don smoke masks or oxygen masks — On and set at 100%.
5. Use a hand fire extinguisher.

SMOKE ELIMINATION.

To eliminate smoke concentration in the cockpit, relief crew compartment, or cabin, open the forward companionway door and the right and left forward emergency exits in the cabin.

CAUTION

Under no circumstances should the pilot's side windows or clear vision windows be opened concurrently with an aft exit or door, as this will cause smoke to be drawn into the cockpit.

EMERGENCY DESCENT PROCEDURE.

Descend from altitude at the highest possible rate of descent as follows:

1. Close throttles.
2. Props — Full INC. RPM (forward).
3. Do not exceed a maximum of 217 knots (250 mph) IAS, gear and flaps UP.
4. If this procedure cannot be used, descend as rapidly as possible with gear and flaps down, power off, props full INC. RPM (forward), cowl flaps open, observing gear and flap down-speed restrictions of 125 knots (144 mph) IAS.

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING).

WARNING

All combustion type heaters must be shutoff before emergency landing.

When an emergency landing is required, unlock the emergency exits, complete the checklist, and make a normal approach. The crew will use the same positions that are required for ditching (figure 3-8). The alarm bell procedure is the same as for ditching. There is always a tendency to overshoot during a belly landing because of the reduction of drag with the gear retracted.

ABORT.

When an engine fails before reaching critical engine failure speed, considerable yawing of the aircraft will occur, and will tend to bank in the direction of the yaw. This effect is greater for an outboard engine failure than for an inboard engine failure. Banking tendencies are aggravated by a crosswind from the side opposite to the failed engine. To control yawing and banking at the instant of engine failure, immediately apply necessary rudder and aileron and perform the following steps:

1. Throttles — CLOSED.
2. Control column forward; steer with nosewheel.
3. Apply brakes.
4. If crash is imminent — Apply emergency air-brakes.
5. Fuel booster pump switches — OFF.
6. Fire extinguisher selector handles — Pull out, if ordered by pilot.
7. Ignition, battery, and generator switches — OFF, if ordered by pilot.

LANDING GEAR TIRE FAILURE.

1. If the nosewheel tire is flat at the time of landing, keep the nosewheel off the ground as long as possible. Prior to landing, move the passengers to the rear as seating permits, and have them fasten seat belts. If cargo can be shifted safely, move enough to obtain an aft cg. Use a minimum of braking. Retract flaps immediately after touchdown.
2. If one or both tires are flat on one main gear, make contact with the nosewheel as quickly as

possible. There is very little actual danger in landing with one flat tire on one main gear. The landing should be made smoothly and taxiing should be done slowly.

3. If both tires are flat on one main gear as a result of striking some object on the runway, there may be more damage than just flat tires. For example, a hydraulic hose also may have torn loose, a wheel may have been broken, or the landing gear itself may have been sprung. The aircraft tends to swerve to the flat tire side. This tendency may be counteracted by using braking on the good tire side and by nosewheel steering, with forward pressure on the control column to give good steering control. The outboard engine on the flat tire side may also be used to assist in holding the aircraft straight, but the engine should be used cautiously as the added power will increase the landing roll.

Blown-Out Tire on Takeoff.

If there is sufficient runway ahead to stop, retard the throttles and stop the aircraft. If there is insufficient runway for a safe stop, ease the aircraft off the ground and DO NOT retract the gear until after visual inspection, as a blown tire may jam the gear in the wheel well. Land the aircraft.

NOSEWHEEL SHIMMY.

Nosewheel shimmy is an indication of an unbalanced condition of the nosewheel or failure of the steering system. If this occurs during takeoff, decreasing the load on the nosewheel will decrease the shimmy tendency; therefore, pull the nosewheel off the ground as soon as possible. If shimmy occurs during the landing roll, decelerate gradually, since loading the nosewheel will increase the shimmy tendency. On landing with a known shimmy condition, keep the nosewheel off the ground as long as possible.

NOSE GEAR RETRACTED — MAIN GEAR DOWN.

Landing with the nose gear retracted and the main gear down, hold the nose of the aircraft up as long as possible. Use the following procedure to make a nose-gear-up landing:

1. Prior to landing, move passengers and cargo to rear to obtain an aft cg.
2. Make a normal landing on the runway in a slightly tail-down attitude.

3. Immediately upon ground contact, apply sufficient up-elevator to keep the aircraft in a level attitude, and retract flaps immediately after touchdown.
4. Maintain this level attitude until full up-elevator is reached and the nose pitches over. If the tail is too low just before elevator effectiveness is lost, nose contact with the ground will be severe.
5. Apply as little braking as possible.
6. During the initial rolling contact with the main gear, the following steps should be accomplished:
 - a. Fuel system controls -- OFF.
 - b. Booster pump switches -- OFF.
 - c. Mixture control levers -- IDLE CUT OFF.
 - d. Master ignition switch -- OFF.
 - e. Battery switch -- OFF.

MISCELLANEOUS EMERGENCY EQUIPMENT—Typical

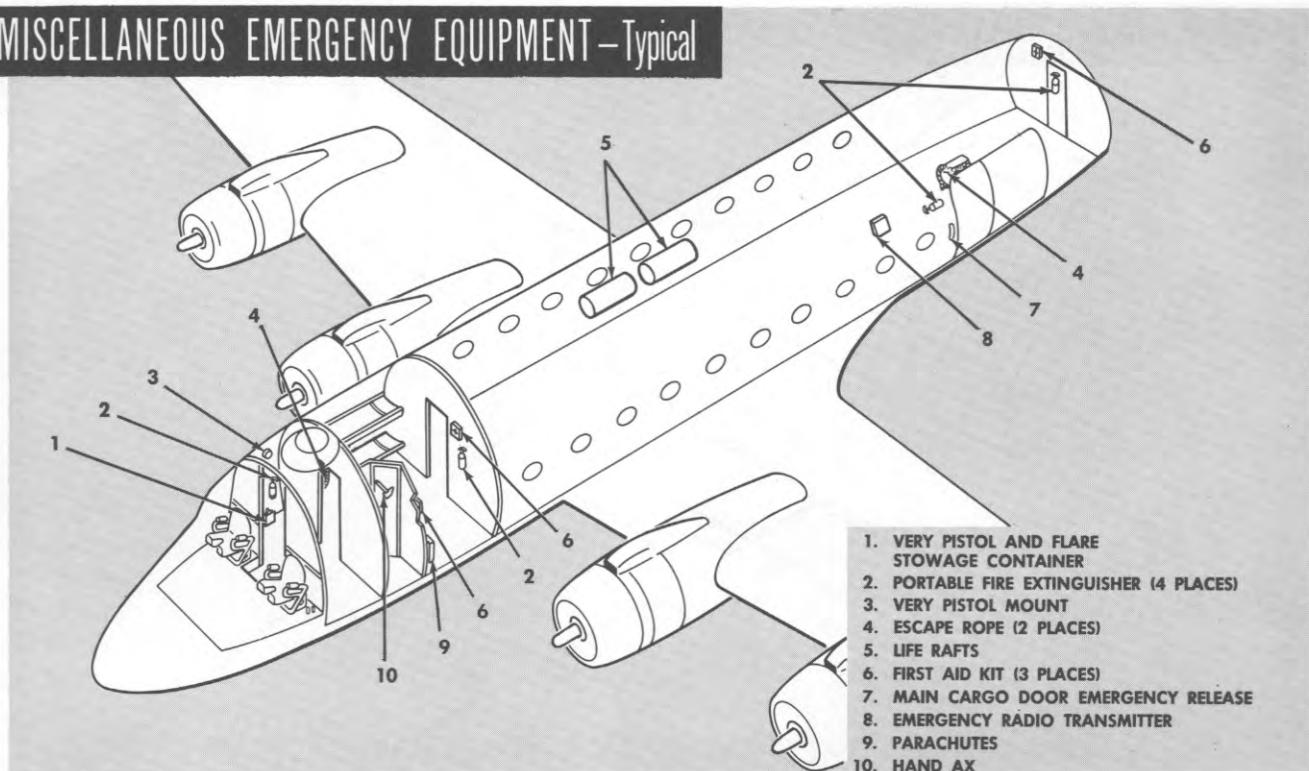


Figure 3-4

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f. Fire extinguisher selector valve handles — Pull out. If a fire breaks out in any nacelle, discharge both cylinders of CO₂.

7. After the aircraft has come to a stop, the crew should stand by with hand-operated fire extinguishers.

Note

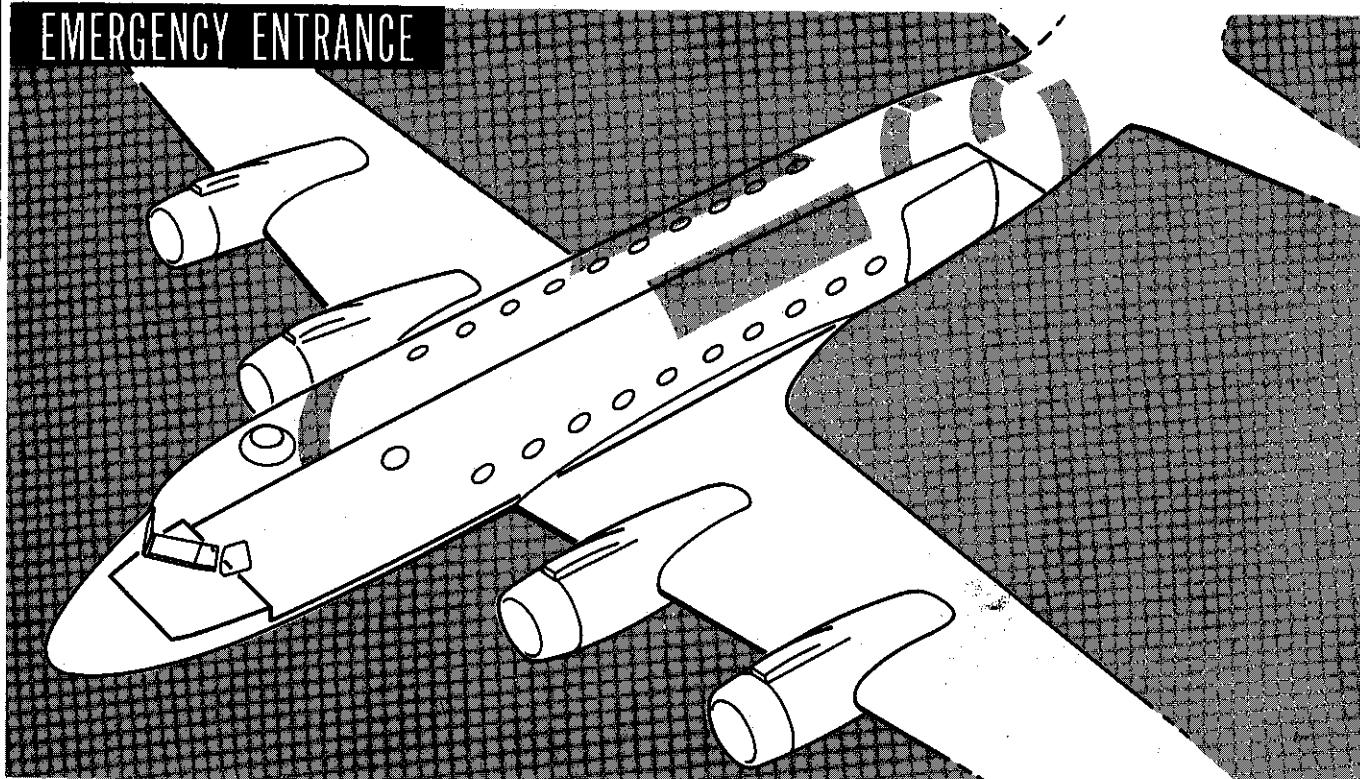
In case the aircraft comes to a stop with the tail resting on the ground, do not permit any movement of passengers or cargo within the cabin, as this may result in upsetting the balance of the aircraft. Wait until the ground crew can install jacking equipment under the nose or tie the tail to a ground securing point.

BELLY LANDING.

When either main gear will not extend, retract the landing gear and make a belly landing.

There is always a tendency to overshoot during a belly landing because of the reduction of drag resulting from the retracted gear. Perform the following steps prior to making a belly landing.

1. If feasible, circle the landing area until the remaining fuel supply is at a minimum to reduce gross weight.
2. Open all emergency exits and jettison forward portion of main cargo door.
3. Jettison all loose cargo and equipment.
4. Warn crew members to assume crash or ditching positions.
5. Make a normal approach.
6. Wing flaps — Full down.
7. Throttles — CLOSE, just prior to contact. (Ground contact should be made in a level to slightly tail-down attitude.)
8. Alarm bell — CONTINUOUS.
9. Immediately prior to ground contact, accomplish the following steps:
 - a. Mixtures — OFF.

EMERGENCY ENTRANCE

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Figure 3-5

- b. Master ignition switch — OFF.
- c. Battery switch — OFF.
- d. Fire extinguisher selector valve handles — Pull out.
- e. Cockpit heater switch and cabin heater temperature control rheostat — OFF.
- 10. Discharge CO₂ after aircraft has come to a stop.
- 3. Cargo may be jettisoned through the rear emergency exits or through the forward portion of the main cargo door.

WARNING

The person jettisoning the cargo door will be secured to the interior of the aircraft fuselage.

JETTISONING.**JETTISONING CARGO IN FLIGHT.**

In case it becomes necessary to jettison cargo in an emergency, care must be taken to avoid damage to the horizontal stabilizer. Proceed as follows:

1. Reduce airspeed to 125 knots (144 mph) IAS maximum.
2. Wing flaps — 10 degrees to attain a tail-high attitude.

EMERGENCY ENTRANCE.

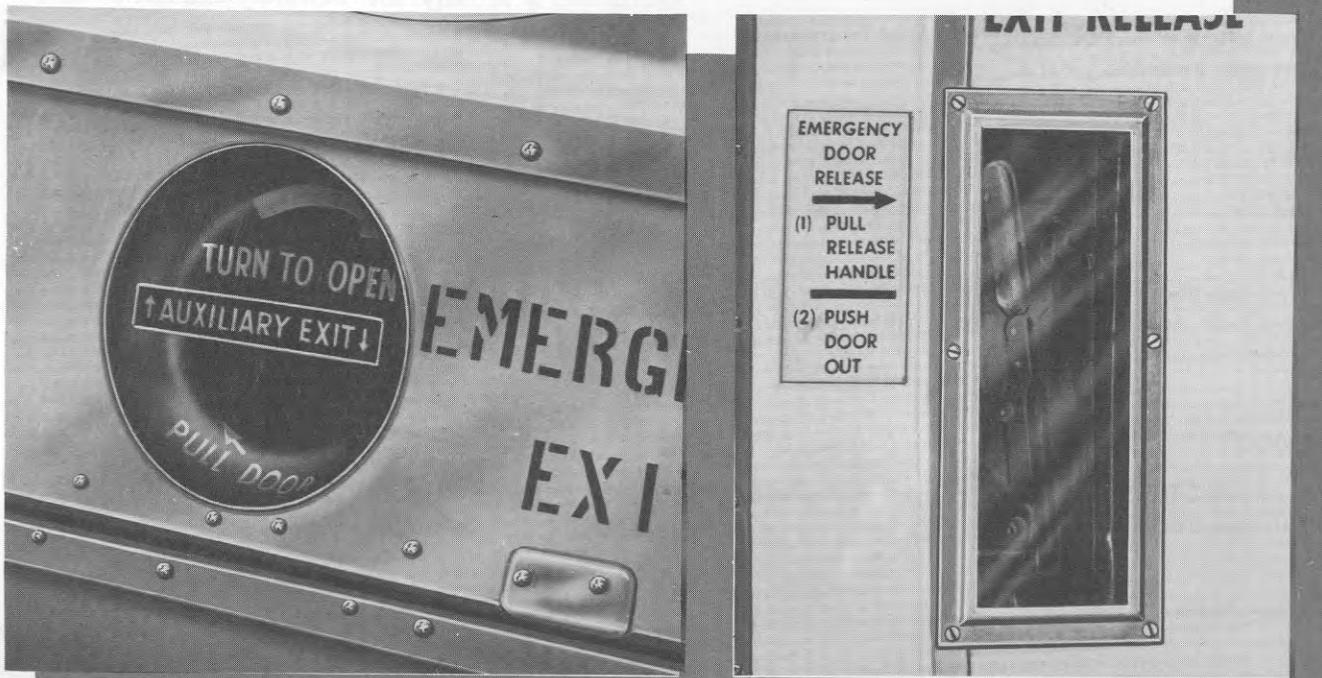
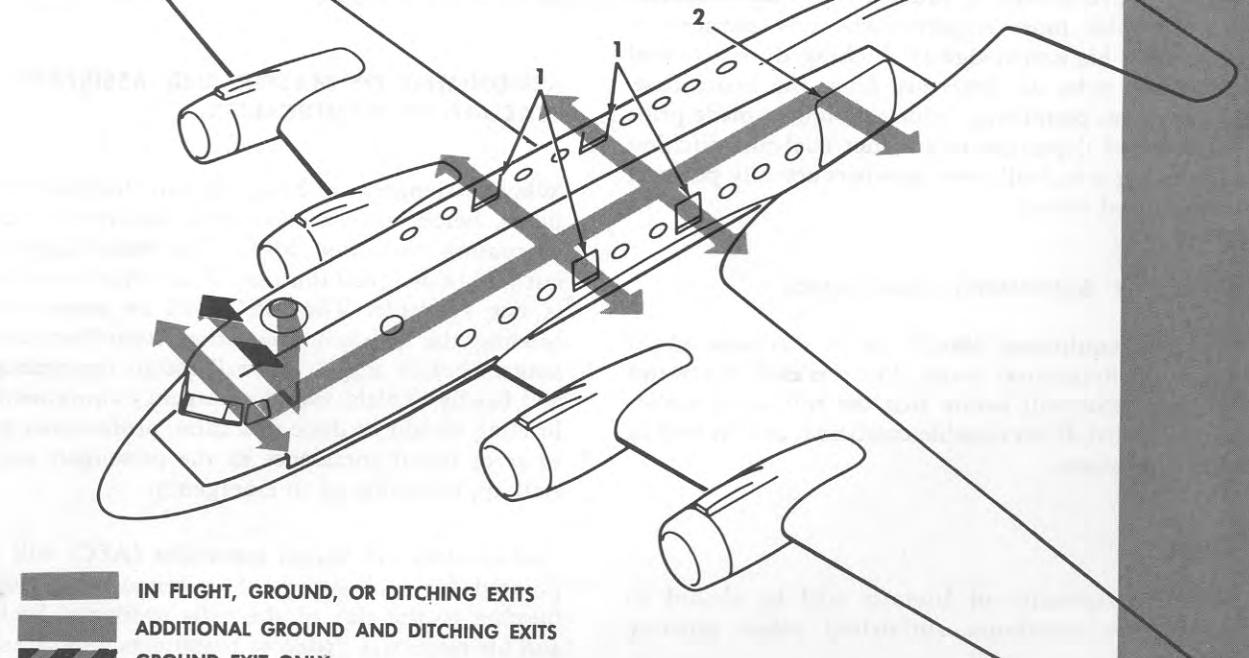
The structure of the fuselage is so designed in various areas that ground personnel can chop through the structure to gain emergency entrance to the aircraft interior. These areas are clearly outlined in yellow on the fuselage outer surface, as shown in figure 3-5.

DITCHING.**DITCHING ALARM BELL.**

The following are the standard alarm signals for ditching:

Six short rings.....Prepare for ditching.
 One long ring.....Prepare for ditching impact.

EMERGENCY ROUTES OF ESCAPE AND EXIT



1. EMERGENCY EXIT (OVER THE WING) DOOR HANDLE (TYPICAL)

2. MAIN CARGO DOOR EMERGENCY RELEASE HANDLE

DITCHING PROCEDURE.

The following ditching procedures are based on experience gained in ditching similar aircraft.

Ditching an aircraft requires more coordination on the part of each crew member than does any other emergency procedure. In order to develop coordination, the pilot must require each crew member to demonstrate his knowledge of ditching duties by oral questioning prior to departure from the home base. Circumstances permitting, efforts should be made prior to the day of departure to conduct trial-run ditching drills during which all crew members actually perform their assigned duties.

EMERGENCY EQUIPMENT LOCATIONS.

Emergency equipment should be in readiness at all times when flying over water. Prior to each overwater flight, the pilot will insure that the following equipment is aboard, in serviceable condition, and stowed in the proper places.

Liferafts.

A sufficient quantity of liferafts will be aboard to accommodate maximum authorized cabin capacity plus crew.

Passenger liferafts will be securely stowed at strategic locations near emergency exits.

Life Vests.

One life vest will be conveniently located for each person on board.

Each crew member will insure that his life vest, CO₂ cartridges, and flashlight are in serviceable condition before each flight.

Emergency Radio Transceiver.

An emergency UHF-VHF transceiver radio is stowed at the radio operator's station.

Emergency Radio Transmitter.

One emergency radio transmitter will be stowed adjacent to the main cargo door.

Anti-Exposure Suits.

One anti-exposure suit will be conveniently located for each person on board when required.

Very Pistol.

Aboard in accessible location.

Emergency Drinking Water.

Aboard in accessible location.

ASSIGNMENT OF MASTER AND ASSISTANT EVACUATION CONTROLLERS.

When passengers are being carried, the pilot will appoint, before takeoff, one crew member as a master evacuation controller (MEC). The senior flight attendant will be assigned this duty if an officer crew member is not available. The MEC will be responsible for briefing the assistant evacuation controllers and passengers before flight. He will assign emergency exits and briefly explain use of emergency equipment. This briefing should be done in a calm, professional manner so as to instill confidence in the passengers and fore-stall apprehension of an emergency.

One assistant evacuation controller (AEC) will be appointed for each group of passengers coinciding in number to the size of the rafts available. Each AEC and his respective group of passengers will be assigned duties and a primary and secondary emergency exit before departure. Crew members will be assigned as AEC's when available. In lieu of crew members, passengers will be selected before boarding the aircraft to act as AEC's as required. Each AEC will occupy a designated seat which will be accessible to his assigned emergency exit.

Note

Whenever possible, condition of the aircraft permitting, the main cargo door should be used as the primary means of exit for all personnel.

PREPARATION FOR DITCHING.

(See figures 3-7 and 3-8.)

Flight Compartment.

At the time the "prepare for ditching" order is given by the pilot, the crew assignments will be:

Pilot and copilot will don anti-exposure suits and life vests, procure flashlights, and remain in their seats to fly the aircraft. The copilot will don a vest containing an emergency radio transceiver.

The crew engineer will obtain anti-exposure suits and life vests for all crew members in the flight compartment, and remove astrodome on pilot's orders after securing loose equipment in the flight compartment. He will don an anti-exposure suit and a life vest, and remain in his seat.

The radio operator will turn the IFF to emergency, don an anti-exposure suit, a vest containing an emergency radio transceiver, and life vest, and remain at his station to transmit necessary emergency messages.

The navigator will place essential navigation equipment, Very pistol, signal flares, and smoke signals in the navigational equipment briefcase. He will then don an anti-exposure suit, and a life vest, and assist the MEC in preparing the main cabin for ditching before proceeding to his ditching station.

Main Cabin Compartment.

When the necessity for ditching is evident, the pilot will alert the crew and have them prepare for ditching.

Upon receiving the command, "prepare for ditching," the MEC will accomplish the following:

Advise the AEC's and passengers of the impending emergency. Assist the AEC's to jettison cargo and baggage through the forward portion of the main cargo door and the two rear emergency exits. Tie down or stow all equipment not jettisoned. Insure that the main cargo doors, which may take in water, are closed and locked.

Order his AEC's to open the No. 2 and 3 emergency exits over the wings and jettison the doors after removal.

Remove tie, loosen collar, don an anti-exposure suit and life vest, and make certain that the AEC's prepare the passengers in the same manner.

After the above procedures have been accomplished, the MEC notifies the pilot that the main cabin and passengers are prepared for ditching.

Upon hearing six short rings of the alarm bell, he checks that all passengers are properly seated and have their safety belts fastened.

Upon hearing one long ring of the alarm bell, he checks that all passengers assume the "Brace for Ditching" position, with life vests inflated and emergency cabin lights (if installed) — ON.

Ditching Positions.

After accomplishing assigned duties in preparation for ditching, each crew member goes to his assigned ditching station (figure 3-8) at once, reporting to the pilot that his assigned duties have been accomplished. Crew

members and passengers fasten safety belts. When impact warning is given, brace yourself and do not relax until aircraft has come to rest. Do not mistake the initial impact of the tail for the greater shock of deceleration that occurs when the nose strikes the water.

WARNING

Serious casualties have occurred in cases where crew members or passengers have not taken proper ditching station, or have relaxed before the final impact.

Abandoning Aircraft.

Evacuation of the aircraft in an orderly manner after ditching should be accomplished in the shortest time possible. This cannot be done well without practice. Far less can it be expected in a dark fuselage filling with water — unless the drill is perfect. Practice makes perfect. The crew and passengers must not leave ditching positions until the aircraft comes to rest. Directly after the aircraft comes to rest, the additional necessary emergency equipment must be collected and equally distributed to the groups on both sides of the main cabin compartment. Each group of passengers, plus the crew, must evacuate the aircraft in the correct order through the emergency exit previously assigned to them, carrying the equipment that has been allotted to them. They must also make sure that each piece of equipment for use in the raft is secured by lines, to prevent its being lost overboard in passing from aircraft to raft. Use the escape rope provided until you are safely in the raft.

Flight Compartment.

When it is certain that the aircraft has come to a complete stop, each crew member accomplishes the following duties:

The pilot and copilot will check each other to see if either one has been injured. It is quite possible for one or both of the pilots to have received severe blows on the head or other parts of the body, making it impossible for them to leave the aircraft under their own power. The copilot will assist the radio operator to launch the raft at the No. 1 emergency exit (main cargo door, (figure 3-8) and board the raft. In case the relief crew compartment door is blocked or jammed, the copilot will assist the radio operator in launching the crew raft through the astrodome exit, if necessary.

DITCHING CHART

CREW MEMBER/DUTY

PILOT

Order crew and passengers to prepare for ditching. Order MEC to assume duties. Order radio operator to start emergency radio procedure. Shoulder harness — Fastened if installed.

CO-PILOT

Shoulder harness — Fastened if installed.
As directed by pilot.

MASTER EVACUATION CONTROLLER OR FLIGHT ORDERLY

Assume MEC duties.
Supervise preparation of passengers.

ASSISTANT EVACUATION CONTROLLER

Make sure that main cargo doors which may take in water are closed and locked. Open No. 2 and No. 3 emergency exits over the wings.

NAVIGATOR

Stow essential navigation equipment in navigational equipment briefcase.

CREW ENGINEER

Stand by to assist pilot and co-pilot.

RADIO OPERATOR

Send emergency signal (SOS) giving position, altitude, course, speed, and intention of pilot.

Note: When possible, the main cargo door will be the primary means of exit. The exits listed below are to be used when the main cargo door is not accessible.

PROVIDE

POSITION

SECONDARY EXIT

Flashlight.

Pilot's seat.

Astrodome or side windows.

Radio transceiver and flashlight.

Copilot's seat.

Astrodome or side windows.

Available survival equipment, life rafts, and first aid kit.

Opposite main cargo door.

Forward emergency exit over right wing.

Available survival equipment, life rafts, and emergency radio transmitter.

Immediately forward main cargo door.

Forward emergency exit over left wing.

Navigational equipment and magnetic compass.

Braced against right main cabin bulkhead or in a front seat.

Forward emergency exit over right wing.

Emergency drinking water and first aid kit.

Braced against left main cabin forward bulkhead or in a front seat.

Forward emergency exit over left wing.

Emergency radio transceiver crew life raft, and first aid kit.

Radio operator's seat

Astrodome or side windows.

Figure 3-7 (Sheet 2 of 2)

Notes:

1. These exits based on non-accessibility of main cargo door. Main cargo door will be used by all crew members, if possible.
2. The below ditching stations are applicable when passengers are aboard or when all cargo has been jettisoned. If cargo is still aboard during ditching, the crew engineer and navigator should brace against the forward Bulkhead of the relief crew compartment (on the Bunks). Emergency exits will remain the same unless the crew compartment door becomes jammed during ditching, in which case the crew engineer and the navigator must exit through the astro-dome.
3. Do not launch rafts from the trailing edge of the wing, as structural damage to the flaps incurred while ditching may puncture the rafts.

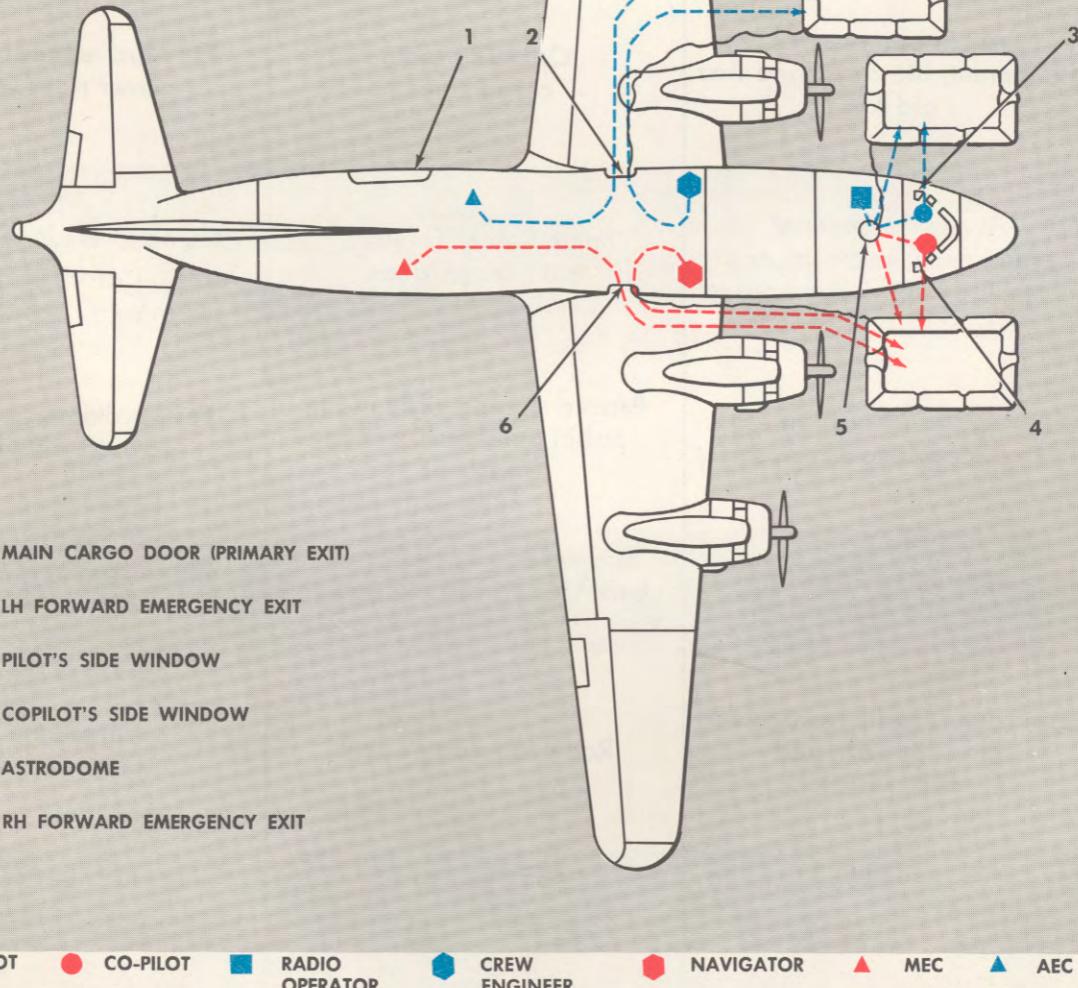


Figure 3-8

The crew engineer, after checking to see that all switches and controls are off, will proceed to the cabin compartment. The battery switch should be left ON at night to provide lights after ditching. He will assist the AEC, if necessary, and go out through the No. 1 emergency exit (main cargo door, *figure 3-8*).

The pilot will destroy the IFF and then go to the relief crew compartment and ascertain that the emergency equipment has been removed and all crew members have been safely evacuated. He will then leave through the No. 1 emergency exit (main cargo door, *figure 3-8*). If the relief crew compartment door is blocked or jammed, he will leave the flight compartment through the astrodome exit to board the crew raft.

Main Cabin Compartment.

The smooth, orderly, and expeditious evacuation of personnel from the main cabin compartment depends upon how well the AEC's perform their duties.

The MEC or flight orderly will supervise and aid the AEC's to insure that all additional emergency equipment is equally distributed among them, and that orderly evacuation is immediately effected.

When it is certain that the aircraft has come to a complete stop, or, upon receiving a "commence evacuation" signal from the MEC or flight orderly, the AEC's will proceed with the following duties:

1. They will cast out the escape ropes through their assigned emergency exits and, aided by their passengers, unlash their emergency equipment.
2. Liferafts will be launched, with the aid of the passengers if necessary. The CO₂ release should not be pulled until after the raft is in the water.

In cases where small rafts are being used instead of the preferred 20-man size, only one raft at a time should be launched and loaded with passengers. The first raft should be tied to the escape rope, the second raft tied to the first, and so on, to prevent them from drifting apart and away from the aircraft.

Rafts launched from the emergency exits over the wings should be preceded by an AEC who will insure their proper inflation, securing, and loading.

3. Each AEC will insure that all emergency equipment, for which he was made responsible, has been collected and distributed among his group.

4. Members of each group, preceded by their AEC, will exit through their assigned emergency exit in the assigned order, taking along their emergency equipment and using the escape rope for support until boarding the raft.

ASTRODOME.

The pilot, copilot, and radio operator will use the astrodome as an alternate emergency exit if the relief crew compartment door is blocked or jammed (*see Note 2, figure 3-8*). A six-man raft stowed in the crew compartment will be launched through the astrodome exit and boarded by the crew members, who will join the other rafts and then board one of the 20-man rafts (if used) as the pilot directs.

Note

The astrodome opens inward.

DITCHING TECHNIQUES.

NORMAL POWER-ON DITCHING.

Experience gained in ditching the aircraft has shown that the best results are obtained by following the outlined procedures.

1. If possible, use up most of the fuel supply to lighten the aircraft and reduce stalling speed. Empty tanks also contribute to flotation.
2. Ditch while power is available. Power will enable you to choose the spot for ditching to obtain the best possible sea conditions and the most favorable landing position and attitude.
3. Use full flaps.
4. Ditch at 10 knots above stalling speed, which will give an approximate angle of ditching of slightly above level flight. Under no circumstances should the aircraft be stalled in, since this will result in severe impact and cause the aircraft to nose into the sea.
5. In daylight, it is recommended that the aircraft be ditched along the top of a swell, parallel to the rows of swells, if the wind does not exceed 30 knots. In high winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed. However, it

must be remembered that the possibility of ramming nose-on into a wave is increased, as is the possibility of striking the tail on a wave crest and nosing in.

PARTIAL POWER FAILURE DITCHING.

When ditching with one or more engines inoperative, the following should be kept in mind.

1. If two engines are inoperative on the same side of the aircraft, use power on the opposite inboard engine only.
2. If power is available from the No. 2 and No. 4 engines, or the No. 1 and No. 3 engines, considerable power may be used to control the aircraft.
3. If symmetrical power conditions exist, use power as required to give the flattest approach and a forward speed of 10 knots above stalling speed.
4. If letting down with an engine inoperative, hold speed 20 knots above stalling speed until flare-out, then reduce airspeed to 10 knots above stalling speed.

CROSSWIND DITCHING.

The basic rules for ditching, listed in normal power-on ditching, will still apply in addition to the following:

1. Crab the aircraft to eliminate drift effect.
2. Land on the downwind side of the swell or wave.

UPWIND DITCHING.

The basic rules for ditching, listed in normal power-on ditching, will still apply in addition to the following:

1. Maintain a nose-up condition; avoid nose striking wave face.
2. Touch down immediately before the crest of a rising wave.
3. Hold the nose up after first impact.

NIGHT DITCHING.

1. Night ditching will be conducted with the aid of instruments to establish proper altitude of aircraft.
2. Make an instrument letdown, holding the airspeed 20 knots above stalling speed and at the lowest possible rate of descent.
3. Use radio low altimeter (0 to 400 feet).
4. Use landing lights as necessary.
5. Hold wings level to avoid digging a wing into the water and cartwheeling the aircraft.
6. Land at 10 knots above stalling speed, using full flaps.

Note

If no power or unsymmetrical power is used, no flaps should be employed.

WIND SPEEDS AND DIRECTIONS.

Surface winds are fairly predictable from the way they affect the water. Use the following reference for estimating the surface wind velocity.

1. No white caps.....0 to 10 knots
2. A few white caps.....10 to 20 knots
3. Many white caps.....30 to 40 knots
4. Many white caps with spray.....40 knots plus

Plans for ditching cannot be made without taking the wind direction into consideration. Waves move downwind and the spray from wave crests is also blown downwind. Swells, however, do not always indicate wind directions and can be very large even when the wind is calm. Swells are the result of underwater disturbances. Over a sea, a pilot must be more exacting and alert when judging height.

PILOT DITCHING.

FIRST ACTIONS.

1. Warn crew and passengers to prepare for ditching and give the approximate time remaining.
2. Order MEC to assume duties.

3. Order crew engineer to obtain life vests and anti-exposure suits for pilot, copilot, navigator, and radio operator.
4. Order radio operator to begin emergency radio procedure.
5. Remove tie, loosen collar, don anti-exposure suit and life vest, and fasten safety belt.
6. Take over controls from copilot and prepare to ditch.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Order radio operator to send final distress signal and lock liaison code key down.
2. Turn on radio altimeter low range (0 to 400 feet).
3. Order all heaters turned off.
4. Order navigator to take charge of cabin and make certain that preparations for ditching are complete.
5. Order all on board to secure themselves in ditching position and have crew engineer check and report.
6. Immediately prior to ditching, order crew engineer and radio operator to secure themselves in ditching position and inform all on board, by interphone, to "brace for impact." Give one long ring on alarm bell.

AFTER DITCHING.

1. Proceed to cabin, and after assuring that all personnel have left the aircraft, leave through the main cargo door.
2. If crew compartment door is blocked or jammed, leave through secondary exit and board the crew raft.
3. Take command.

Note

The pilot and MEC, in conference prior to departure, will determine the distribution of personnel in rafts.

COPILOT DITCHING.

FIRST ACTIONS.

1. Take control of aircraft while pilot adjusts his equipment.
2. Take emergency action on UHF and VHF. Transmit "MAYDAY" and identification 3 times, followed by distress message.
3. Remove tie, loosen collar, don anti-exposure suit, a vest containing an emergency radio transceiver, and life vest, and fasten safety belt.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Assist pilot.
2. If ditching during darkness, instruct all crew members to turn on emergency flashlights attached to life vests.

AFTER DITCHING.

1. Proceed to cabin and assist radio operator in launching raft at main cargo door.
2. Assist passengers or patients in boarding raft.
3. Board raft at main cargo door.
4. If main cargo door or crew compartment door is blocked or jammed, assist radio operator in launching crew raft through astrodome exit.

**MASTER EVACUATION CONTROLLER OR
FLIGHT ORDERLY DITCHING.**

FIRST ACTIONS.

1. Advise AEC's and passengers of the impending emergency.
2. Assist AEC's in jettisoning cargo and baggage not necessary for survival after ditching.
3. Remove tie, loosen collar, don anti-exposure suit and life vest, and supervise preparation of passengers.
4. Notify pilot when main cabin is prepared for ditching.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Make sure that passengers are properly seated and secured. If ditching during darkness, instruct all passengers to turn on emergency flashlights attached to life vests.
2. Proceed to ditching station.

AFTER DITCHING.

1. Assure that the rafts are properly launched and emergency equipment evacuated. Assist passengers or patients to board rafts at main cargo door.
2. Board raft at main cargo door with first aid kits.
3. If main cargo door is not accessible, assist navigator in launching raft through secondary exit over the right wing.

NAVIGATOR DITCHING.

FIRST ACTIONS.

1. Pass position, time, course, speed, altitude, nature of distress, and intentions of the pilot, to the radio operator for inclusion in the distress message.
2. Remove tie, loosen collar, don anti-exposure suit, and life vest.
3. Fasten navigator's stool to floor directly below astrodome.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Stow essential navigational equipment including Very pistol, flares, smoke signals, and aircraft's compass in briefcase.
2. Make sure that all preparations for ditching are complete in the main cabin.
3. Proceed to ditching station with navigational equipment briefcase. (See Note 2, figure 3-8.)

AFTER DITCHING.

1. Launch raft at the No. 1 emergency exit (main cargo door) and board raft with navigational equipment briefcase.
2. Assist passengers or patients to board raft.
3. If main cargo door is not accessible, assist MEC launch raft through secondary exit over the right wing.

CREW ENGINEER DITCHING.

FIRST ACTIONS.

1. Obtain life vests and anti-exposure suits for all crew members in the flight compartment.
2. Secure all loose objects in the flight compartment.
3. Remove tie, loosen collar, don anti-exposure suit, and life vest.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. On order from pilot, remove astrodome.

WARNING

It must be kept in mind that the astrodome opens inward, not outward.

2. Check and report all personnel in ditching position.
3. On order from pilot, proceed to ditching station. (See Note 2, figure 3-8.)

AFTER DITCHING.

1. Assist AEC in launching raft at No. 1 emergency exit (main cargo door).
2. Assist passengers or patients in boarding the raft.

3. Board raft with first aid kit and drinking water.
4. If main cargo door is not accessible, assist AEC launch raft through secondary exit over the left wing.

RADIO OPERATOR DITCHING.

FIRST ACTIONS.

1. On order from the pilot, turn the IFF to EMERGENCY, send emergency distress signal (SOS), followed as soon as possible by emergency message giving position, flight time, course, speed, altitude, nature of distress, and intentions of pilot, on air-ground frequency in use at the time.
2. On pilot's request, contact Direction Finding Service, if possible, and obtain bearings and fixes.
3. Remove tie, loosen collar, don anti-exposure suit, a vest containing an emergency radio transceiver, and a life vest.
4. Continue emergency rescue communications procedures every 10 minutes.

WHEN DITCHING IS IMMINENT (10 MINUTES LEFT).

1. Send final distress signal (SOS) and emergency message.
2. On order from pilot, turn the emergency keyer switch on and proceed to ditching station.

AFTER DITCHING.

1. Launch raft at main cargo door.
2. Board raft with emergency radio transceiver and first aid kits.
3. Assist passengers or patients in boarding the raft.
4. If main cargo door is not accessible, assist co-pilot in launching crew raft through astrodome exit.

ASSISTANT EVACUATION CONTROLLER DITCHING.

FIRST ACTIONS.

1. Remove emergency doors No. 2 and 3.
2. Jettison all possible baggage and cargo not necessary for survival after ditching.
3. Assist passengers or patients in preparation for ditching.
4. Secure loose equipment in cabin.
5. Remove tie, loosen collar, don anti-exposure suit and life vest.

WHEN DITCHING IS IMMINENT (10 MINUTES LEFT).

1. Caution passengers not to smoke.
2. Brief passengers as to location of emergency exits and raft assignments.
3. Proceed to ditching station.

AFTER DITCHING.

1. Launch raft at main cargo door.
2. Assist passengers or patients in boarding raft.
3. Board raft with emergency radio transmitter and all extra equipment and rations possible, or as time permits.
4. If main cargo door is not accessible, assist crew engineer in launching raft through secondary exit over the left wing.

FLIGHT NURSE DITCHING.

FIRST ACTIONS.

1. Advise patients of situation.
2. Assist patients to don anti-exposure suits and life vests.

3. Check and fasten litter safety belts on all patients and check secureness of litters and litter straps.
4. Remove tie, loosen collar, and don anti-exposure suit and life vest.
5. Collect necessary medical supplies.
6. Instruct patients as to procedure of evacuation from aircraft.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Give final warning to patients.
2. Proceed to ditching station.

DITCHING STATION—Seat near forward emergency exit over the left wing, if available, or in sitting position facing rear, back and head braced against a bulkhead.

AFTER DITCHING.

1. Direct loading of patients into rafts through main cargo door.
2. Exit through main cargo door with medical supplies and board raft.
3. If main cargo door is not accessible, direct evacuation of patients through forward emergency exit over left wing.

SECOND FLIGHT NURSE DITCHING.

FIRST ACTIONS.

1. Assist flight nurse as directed.
2. Assist patients to don anti-exposure suits and life vests.
3. Remove tie, loosen collar, and don anti-exposure suit and life vest.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Assist flight nurse as directed.
2. Proceed to ditching station.

DITCHING STATION—Seat near No. 1 emergency exit (main cargo door) if available, or in sitting position facing rear, back and head braced against a bulkhead.

AFTER DITCHING.

1. Assist loading of patients into raft through No. 1 emergency exit (main cargo door).
2. Board raft.
3. If main cargo door is not accessible, assist flight nurse in evacuating patients through forward emergency exit over left wing.

MEDICAL TECHNICIAN DITCHING.

FIRST ACTIONS.

1. Assist patients to don anti-exposure suits and life vests.
2. Check and fasten litter safety belts on all patients and check secureness of litters and litter straps.
3. Remove tie, loosen collar, and don anti-exposure suit and life vest.

**WHEN DITCHING IS IMMINENT
(10 MINUTES LEFT).**

1. Assist flight nurse as directed.
2. Proceed to ditching station.

DITCHING STATION—Seat near forward emergency exit over the right wing.

AFTER DITCHING.

1. Assist loading of patients into raft through main cargo door.
2. Board raft through main cargo door unless directed otherwise by flight nurse.
3. If main cargo door is not accessible, load patients and board raft through forward emergency exit over the right wing.

BAILOUT.

See figure 3-6 for emergency exits in flight.

BAILOUT ALARM BELL.

The following are the standard alarm signals for bailout:

Three short rings.....Prepare for bailout.

One long ring.....Bailout.

BAILOUT PROCEDURE.

Upon the first indication of an emergency, the pilot will give a warning signal to "prepare for bailout." This signal will be three short rings on the alarm system. When all the passengers are ready for bailout, the pilot will be notified by the master evacuation controller or flight orderly. When the pilot desires to have all on board abandon the aircraft, he will give a warning signal to bailout, which will be one long sustained ring on the alarm system. In addition to the alarm signals, the pilot will give verbal warnings over the interphone. The senior flight attendant or flight orderly will ordinarily be the master evacuation controller (MEC), but any crew member may be called upon in an emergency. Exit will normally be through the No. 1 emergency exit (main cargo door).

Pilot will:

1. Notify crew and receive acknowledgement. Ring alarm bell three short rings. (This will be the automatic signal for the crew members to perform all preparatory duties for bailout.)
2. Slow the aircraft, 20° flaps, 130 percent stall speed.
3. Put the aircraft on autopilot.
4. Don anti-exposure suit and life vest if over water.
5. Don his parachute.
6. Give the "bailout" signal of 1 long ring on the alarm bell.
7. After receipt of all clear signal from the MEC or flight orderly, the pilot will order the crew engineer to bail out and will follow him out.

Copilot will:

1. Acknowledge the pilot's bailout instructions, don anti-exposure suit and life vest if over water, and don his parachute.
2. Transmit emergency voice signals.
3. Extend and turn on landing lights (night only).
4. Assist pilot in duties so designated until the bailout signal is given.
5. Evacuate aircraft on the final bailout signal.

Navigator will:

1. Acknowledge pilot's bailout instructions, don anti-exposure suit and life vest if over water, and don his parachute.
2. Give final aircraft position report to the pilot, copilot, and radio operator.
3. Evacuate aircraft on the final bailout signal.

Crew Engineer will:

1. Assist pilot in coping with the emergency.
2. Acknowledge pilot's bailout instructions, don anti-exposure suit and life vest if over water, and don his parachute.
3. Remain in seat until ordered to abandon aircraft by pilot.

Radio Operator will:

1. Acknowledge pilot's bailout instructions and turn the IFF switch to the EMERGENCY position.
2. Transmit distress signal and position report, and continue to do so until the final bailout signal.
3. Don anti-exposure suit and life vest if over water and don his parachute.
4. Turn the emergency keyer switch ON and destroy the IFF.
5. Evacuate the aircraft on final bailout signal, taking code book and radio operator's flimsy (notebook).

Senior Flight Attendant (MEC) or Flight Orderly will:

1. Acknowledge the pilot's bailout instructions and order bailout controllers to prepare passengers for bailout.
2. Assure the removal of designated inflight escape exit doors by the bailout controllers.
3. Don anti-exposure suit and life vest if over water and don his parachute.
4. Contact the pilot by interphone and advise him when passengers are ready to bail out.
5. Upon receipt of the bailout signal, supervise orderly movement of passengers through the bailout exits.
6. After all personnel in the main cabin have bailed out, notify the pilot by interphone and receive acknowledgment. (If a definite acknowledgment is not received, he goes to the cockpit and notifies the pilot.)
7. Evacuate the aircraft.

OVERWATER AND ARCTIC RECOMMENDATIONS.

Bailout is not recommended unless visual contact is made with adequate surface help. If no rescue vessels are in the vicinity, bailout should be used only as a last resort because of the extreme difficulty of getting the crew together in the water. In any but the warmest seas, a man will survive only a few hours if kept afloat by means of a life vest alone. Wearing an anti-exposure suit will increase this time, but it still cannot compare with the length of time survival is possible in a liferaft. If bailout is required or decided upon, the following procedure is recommended:

1. If surface help is available, it is much easier for rescue crews to find and rescue two or three men at a time in a small area than to rescue 10 or more men strung out in a long line in the water. Always head the aircraft in a direction to allow the crew to drift onto the course and just ahead of the rescue vessel.
2. If surface help is not available, it is still important to keep the crew as close together as possible in the water. Individual members can aid each other, especially in regard to injured members. Most important of all, a group of men on liferafts is much easier to find than a single individual. This is true whether the search is from a surface vessel or from an aircraft. In view of the above, jettison inflated rafts if possible.

The aircraft should be flown in as tight a circle as conditions will permit, level out to reduce excessive G's, bail out three or four men at a time, and then come around in relation to the other men or the surface vessel, before bailing out the other members. This should be accomplished in order to place the members as close as possible to the other men or the surface vessel.

3. As in ditching, try to plan the bailout before the last minute. The pilot must warn the crew as soon as bailout is decided on. Give three short rings on the alarm bell, and, if time permits, warn the crew.
4. When the bailout warning is given, crew members should check each other's equipment to insure that all straps and packs are properly secured and adjusted.

Upon receiving the bailout signal, crew and passengers will evacuate with the least possible delay through the main cabin door, in accordance with the above procedure, or as prescribed by the pilot to cope with the present emergency.

AIRCRAFT SYSTEMS.**FUEL SYSTEM FAILURE.****Vapor Lock.**

The fuel system can malfunction as a result of a vapor lock, a condition which occurs when the fuel boils or when the fuel is supersaturated with air. The usual indications of a vapor lock start with regular and rapid engine surging at high frequency, coupled with rapid fuel pressure and fuel flow fluctuations. This is usually followed by an irregular surge of greater magnitude with extreme fuel pressure and flow fluctuations. In the final stage, the surge can become great enough to lead to complete engine failure.

Any type of vapor lock can be rapidly and completely broken by placing the fuel booster pump switch in the LOW position to pressurize the main fuel system line and force the air and fuel vapor back into solution with the fuel. Continuous use of LOW boost will de-aerate the fuel in the tank.

ELECTRICAL POWER SYSTEM FAILURE.

See figure 3-9, malfunctions of multi-generator d-c power system.

Circuit Breakers.

If a circuit breaker opens, disconnecting power to any circuit, it indicates an overload or short in that circuit. If the circuit breaker reopens after being reset, do not use that circuit unless the safety of the aircraft depends upon its continued operation.

WARNING

Manually holding a circuit breaker closed after it has been reset and has reopened constitutes a fire hazard, inasmuch as the circuit is then functioning without adequate protection.

Generators.

If there is no indication on one ammeter, but the others indicate normal readings, make the following check.

1. Check the generator voltage, which should be the same as that of the other generators (approximately 28 volts).
2. If the switch for the malfunctioning generator is ON, turn it OFF and see whether the readings of the other ammeters increase. If they do, the trouble may be attributed to the ammeter. Place the generator switch momentarily to RESET, then to ON.
3. In case a generator failure warning light illuminates, indicating a fault in the generator system, place the generator switch momentarily to RESET, then ON. If the warning light does not go out and stay out, turn the generator switch OFF and check the generator field reset circuit breaker on the generator circuit breaker panel in the crew lavatory. If the generator field reset circuit breaker retrips, the generator can be reset with the generator switch ON by depressing the reset pushbutton on the generator field control relay in the top of the generator control equipment junction box located in the crew lavatory. If the generator failure warning light does not go out, turn the generator switch OFF.

CAUTION

It may be necessary to monitor the electrical load before turning off a generator, to prevent the remaining generators from becoming overloaded.

4. If the generator voltage reads zero and the generator failure warning light is illuminated, check the field circuit breaker on the generator circuit breaker panel in the crew lavatory. If it has tripped, reset it. If it immediately retrips, leave it off and turn the generator switch OFF.

Inverter Failure.

In the event that the NORMAL inverter fails, the radar inverter, which supplies power to the AN/APS-42 radar equipment, can be used by placing the switch on the electrical control panel in the EMER position. The AN/APS-42 radar equipment is inoperative when the pilot must use the radar inverter for radio and electrical loads. Failure of a-c power is indicated by illumination of a red INVERTER FAILURE LIGHT, located below the inverter switch.

D-c Bus Failure.

In the event of failure of the d-c power distribution system, no electrical power will be available to the aircraft electrical systems except the alarm bell which is connected directly to the batteries.

Batteries.

In case of complete generator failure, all electrical loads should be monitored to conserve the energy of the batteries. Heavy loads such as suit heaters and buffet should be turned off, and only essential radio or electrical equipment should be used. Start APP if installed.

HYDRAULIC POWER SYSTEM FAILURE.

In the event of hydraulic system failure (location of failure unknown), proceed as follows:

1. Place all hydraulic unit controls in the OFF or NEUTRAL position.
2. Place the hydraulic bypass valve handle in the OFF (up) position. If the handle cannot be pulled up or if the engine pump pressure cannot be bypassed, pull the emergency landing gear extension handle OPEN and move the landing gear lever to UP. In this condition, the emergency gear extension valve acts as a bypass.
3. Check the hydraulic fluid quantity. If the quantity is normal, an internal system leak (such as a valve stuck open) is indicated, and the system may be operated without loss of fluid. However,

MALFUNCTION OF MULTI-GENERATOR

VISUAL INDICATION OF MALFUNCTION - ALL GENERATOR SWITCHES "ON"

DEFECTIVE GENERATOR

OTHER GENERATORS

	VOLTS APPROXIMATE	AMPS	GENERATOR "OFF" LIGHT	VOLTS APPROXIMATE	AMPS	GENERATOR "OFF" LIGHT
1(A)	0	0	ON	28	NORMAL	OUT
1(B)	1-2	0	ON	28	NORMAL	OUT
2(A)	1-2	0	ON	28	NORMAL	OUT
2(B)	FULL SCALE	0	ON	28	28	OUT
3	ABOVE 30	FULL SCALE	OUT	1-2	0	ON
4(A)	1-2	0	ON	1-2	0	ON
4(B)	FULL SCALE	0	ON	1-2	0	ON
4(C)	ABOVE 30	FULL SCALE	OUT	28 OR 1-2	0	ON
5(A)	28	HIGHER THAN OTHERS	OUT	28	ABOUT EQUAL BUT LOWER THAN HIGH ONE	OUT

Figure 3-9 (Sheet 1 of 4)

DC ELECTRICAL SYSTEMS

POSSIBLE NATURE OF FAILURE

ACTION BY FLIGHT PERSONNEL

DEFECTIVE GENERATOR.

LEAVE FAILED GENERATOR SWITCH "OFF." SEE NOTE (2)G.

OPEN FIELD CIRCUIT.

CHECK FIELD CIRCUIT BREAKER. RECLOSE IT IF TRIPPED. IF IT TRIPS AGAIN, LEAVE IT OPEN AND LEAVE FAILED GENERATOR SWITCH "OFF." SEE NOTE (2)G.

OVERVOLTAGE.

LEAVE FAILED GENERATOR SWITCH "OFF." SEE NOTE (2)G.

OVERVOLTAGE CONDITION NOT CLEARED BY TRIPPING OF GENERATOR FIELD RELAY.

LEAVE FAILED GENERATOR SWITCH "OFF." SEE NOTE (2)G.

OVERVOLTAGE BUT FAILED GENERATOR FIELD RELAY DID NOT TRIP. FIELD RELAYS ON OTHER GENERATORS TRIPPED.

PUT GENERATOR SWITCH OF HIGH VOLTAGE GENERATOR TO "OFF" POSITION, THEN IMMEDIATELY PUT OTHER GENERATOR SWITCHES TO "RESET," THEN TO "ON" POSITIONS. LEAVE HIGH VOLTAGE GENERATOR SWITCH IN "OFF" POSITION. SEE NOTE (2)G.

ALL OVERVOLTAGE RELAYS HAVE TRIPPED DUE TO FAULT ON ONE GENERATOR.

IMMEDIATELY ATTEMPT TO RESET, THEN TURN "ON" ALL GENERATORS, ONE AT A TIME. THE FAULTY GENERATOR WILL PROBABLY TRIP AGAIN AND MAY TRIP ANY OTHER THAT HAS BEEN RESET AND RECLOSED. IF SO, PUT THE GENERATOR SWITCH OF THE FAULTY GENERATOR TO "OFF," THEN RESET AND TURN "ON" THE OTHERS. SEE NOTE 2(G).

ALL OVERVOLTAGE RELAYS HAVE TRIPPED DUE TO FAULT ON ONE GENERATOR.

TURN "OFF" THE GENERATOR SWITCH FOR THE GENERATOR THAT SHOWS HIGH VOLTAGE. LEAVE IT "OFF," THEN RESET AND TURN "ON" THE OTHERS. SEE NOTE (2)G.

OVERVOLTAGE CAUSED BY "A" TO "B" SHORT CIRCUIT AT THE GENERATOR WHICH CAUSED THE REVERSE CURRENT RELAY TO WELD ITS CONTACTS WHEN IT TRIED TO TRIP AFTER THE GENERATOR FIELD RELAY TRIPPED.

TURN GENERATOR SWITCH "OFF." TURN OTHER GENERATOR SWITCHES TO "RESET," THEN TO "ON." REVERSE CURRENT RELAY ON THE FAULTY GENERATOR WILL PROBABLY TRIP AGAIN AND MAY TRIP ANY OTHER THAT HAS BEEN RESET AND RECLOSED. IF SO, PUT THE GENERATOR SWITCH OF THE FAULTY GENERATOR TO "OFF," THEN RESET AND TURN "ON" THE OTHERS. SEE NOTE 2(G).

GENERATORS NOT PROPERLY PARALLELED.

UNEQUAL LOAD DIVISION IS NOT SERIOUS AS LONG AS ALL GENERATORS INDICATE SOME LOAD UNLESS ONE OR MORE INDICATE AN OVERLOAD. SEE NOTE (2)F.

MALFUNCTION OF MULTI-GENERATOR

VISUAL INDICATION OF MALFUNCTION — ALL GENERATOR SWITCHES "ON"

DEFECTIVE GENERATOR			OTHER GENERATORS			
	VOLTS APPROXIMATE	AMPS	GENERATOR "OFF" LIGHT	VOLTS APPROXIMATE	AMPS	GENERATOR "OFF" LIGHT
5(B)	28	LOWER THAN OTHERS	OUT	28	ABOUT EQUAL BUT HIGHER THAN LOW ONE	OUT
6	28 OR FLUCTUATING	FLUCTUATING NEAR 0	BLINKING	28	NORMAL	OUT
7	BELow 28	FULL SCALE	ON	28	NORMAL	OUT
8	28	0	ON	28	NORMAL	OUT
9	LOW	FULL SCALE	OUT OR BLINKING	LOW	FULL SCALE	OUT OR BLINKING

Note (1) Generator switch controls the following components: reverse current relay, generator "OFF" indicator light, generator field relay reset coil, and voltage regulator equalizer coil.

- Generator switch in "ON" position permits the main contactor of the reverse current relay to close if the differential relay contacts are closed and connects the voltage regulator equalizer coil to the equalizer bus. The generator "OFF" light goes out when the reverse current relay closes.
- Generator switch in "OFF" position causes the reverse current relay to open, the generator "OFF" indicator light to be out, and opens the voltage regulator equalizer circuit.
- Generator switch in "RESET" position resets the field relay if it has tripped. Field relay may also be reset manually by pressing the "RESET" button on the relay. The field relay is tripped by the overvoltage relay only, not manually.
- The generator reverse-current relay closes automatically when the generator voltage is approximately 0.5 volt higher than the bus voltage, provided the generator switch is "ON" and the generator voltage is higher than 18 volts. It opens automatically when approximately 30 amps. flows from the bus toward the generator.

(2) SAFETY PRECAUTIONS IN CONNECTION WITH ELECTRICAL SYSTEM.

- Do not remove a voltage regulator without first opening the field circuit breaker. Except in emergency, voltage regulators should not be removed in flight.
- In the event a generator current limiter burns out, or blows, the cause of the failure should be determined and corrected before the limiter is replaced.
- If the generator "OFF" light, or the generator load meter, indicates that the generator has failed, check the load meters on the remaining generators. If an overload is indicated, non-essential load equipment should be switched "OFF."
- All generators should be operating and properly paralleled before take-off.

DC ELECTRICAL SYSTEMS

POSSIBLE NATURE OF FAILURE

ACTION BY FLIGHT PERSONNEL

GENERATORS NOT PROPERLY PARALLELED.

UNEQUAL LOAD DIVISION IS NOT SERIOUS AS LONG AS ALL GENERATORS INDICATE SOME LOAD UNLESS ONE OR MORE INDICATE AN OVERLOAD. SEE NOTE (2)F.

UNSTABLE VOLTAGE REGULATOR.

TURN GENERATOR SWITCH "OFF" FOR GENERATOR ON WHICH GENERATOR "OFF" LIGHT IS BLINKING. LEAVE THIS GENERATOR SWITCH "OFF." SEE NOTES 2(A) AND 2(G).

GROUND FAULT ON GENERATOR FEEDER.

TURN GENERATOR SWITCH TO "OFF" POSITION. LEAVE IT "OFF." TRIP FIELD CIRCUIT BREAKER AND LEAVE IT OPEN. SEE NOTE (2)G.

GENERATOR FEEDER CURRENT LIMITER BLOWN.
DEFECTIVE REVERSE CURRENT RELAY.

TURN GENERATOR SWITCH TO "RESET," THEN TO "ON." IF GENERATOR DOES NOT INDICATE LOAD ON THE LOAD METER, TURN GENERATOR SWITCH TO "OFF" AND LEAVE IT "OFF."

GROUND FAULT ON MAIN BUS.

TURN "OFF" BATTERY AND ALL GENERATOR SWITCHES. INSPECT MAIN BUS FOR FAULT AND CORRECT THE TROUBLE IF POSSIBLE. IF NOT POSSIBLE TO REMOVE GROUND FAULT, FLIGHT MUST CONTINUE WITHOUT THE ELECTRICAL SYSTEM.

- e. Minimum speed for rated output of the generators (type R1) is approximately 1450 RPM of the main engines. The minimum speed for any usable output is approximately 1250 RPM of the main engines. Therefore, during taxiing and standby for take-off, one or two of the engines should be operated above 1250 RPM. Otherwise, unless there is an aux. power plant installed and operating, the battery may discharge considerably.
- f. Generators should be properly paralleled. Allow generators to operate with a total of at least 200 amps, with main engine speed at least 1250 RPM for 15 minutes to permit voltage regulators to warm up before attempting to equalize load. In the normal installation where Type R1 generators are installed, the equalizing voltage is the drop across a resistor connected between the generator "E" terminal and ground. The voltage drop across this resistor is 0.5 volts at 300 amp. If a paralleling potentiometer is installed on the voltage regulator base, it must be adjusted to the extreme end which provides highest paralleling voltage to the regulator. Accomplish load equalization by adjusting the voltage adjustment resistor on the regulator. An accurate voltmeter must be used. With the generator switch "OFF" adjust each regulator to 28V. With all generator switches "ON," with at least total load of 200 amp, and engine speed at 1450 RPM, the difference between the highest ammeter reading and the lowest should not be more than 10 amp. In flight it is neither necessary nor advisable to frequently adjust regulators to maintain close load division as long as all generators are carrying load and no one is overloaded. If one or more generators must be turned off in flight, it may be necessary to adjust for equal load division. If so, always adjust the highest one down. Otherwise a high bus voltage may result.
- g. If for any reason the total number of operating generators is reduced, the load meters must be observed to determine if any generator is in danger of being overloaded. If so, certain nonessential, or least essential, loads must be turned off. If a generator is operated at overload, there is not only the danger of burning out the generator but also the danger of blowing the generator feeder current limiter. This is especially true for single, or perhaps even two, generator operation. Normally do not turn off an overloaded generator, as to do so merely transfers the load to the remaining generators and makes the overload condition worse. Either adjust the voltage regulator DOWN on the overloaded generator or REDUCE the load.

the pressure may be lower and actuation of the units may be slower than during normal operation. If the quantity is excessively low, an external system leak is indicated and the remaining procedures should be completed upon arrival at the nearest terminal airport, at pilot's discretion.

Note

In the event of an external leak, the engine pumps may pump overboard all hydraulic fluid in excess of 2.5 gallons, which will remain in the reservoir for emergency use by the hand pump.

4. Place the landing gear lever in the DOWN position, and wait until the gear extends and locks by free-falling. If the landing gear does not extend and latch, as indicated by the indicator lights, pull the emergency gear extension handle to the OPEN position. If the gear still does not extend and lock move the hydraulic hand pump selector handle to the CLOSED position, move the emergency gear extension handle to the CLOSED position, and operate the hand pump until the gear is completely extended and the green indicator lights are illuminated. When the gear indicates down and locked, return the landing gear lever to NEUTRAL. It may require approximately 60 cycles of the hand pump handle to prime the pump and supply hydraulic pressure to the landing gear system.

Note

If the uplatches fail to release after the landing gear lever has been placed in the DN position, full downline pressure from the hydraulic hand pump will shear the uplatch shear bolts, permitting the gear to extend and lock.

5. Test the brakes by applying toe pressure to the brake pedals and operating the hand pump with the hand pump selector handle in the CLOSED position. (Back pressure on the brake pedals indicates that the brakes are receiving hand pump pressure and should be operable.) Do not pump the brake pedals, as pumping will reduce brake pressure because hydraulic fluid, under pressure in the brake control valves, enters the return line to the hydraulic reservoir each time the brake pedals are released.

6. Wing flap position is a function of operating conditions and is left to the pilot's discretion. If a flaps down setting is desired, place the bypass valve in the ON (down) position to obtain maximum flap extension possible with remaining main system fluid pressure. Move the flap lever to the DN position. Use the hand pump as necessary to obtain desired flap setting. After the desired flap setting is obtained, return the wing flap lever to the OFF position and the bypass valve to the OFF (up) position.

7. Prior to landing, return the bypass handle to the ON (down) position and the landing gear lever to the DN position. Place the hand pump selector handle in the CLOSED position and use the hand pump as necessary during landing and rollout to insure braking. Apply the brakes steadily and do not release. If brake pressure drops, be prepared to use the emergency airbrakes.

Emergency Airbrake Operation.

If no hydraulic pressure is available to operate the brakes, the emergency airbrake system can be used to brake the aircraft. After touchdown, use aerodynamic braking as long as possible. Do not use the airbrakes until the nosewheel is on the ground. On most aircraft there is no intermediate position of the airbrakes; they are either full ON or OFF. On some aircraft however, the airbrake system employs a metering valve which permits gradual application of the airbrakes. However, this metering method should not be used. Instead, allow the aircraft to reduce speed during ground roll, runway length permitting, then apply full airbrake system pressure.

Excessive Hydraulic Pressure in Flight (3300 Psi Plus).

If the hydraulic pressure regulator valve is sticking and the hydraulic bypass valve handle cannot be pulled up, accomplish the following:

1. Emergency gear extension handle—OPEN (Aft).
2. Landing gear lever — UP.
3. Bypass valve handle — UP.

If the bypass handle still will not come up, there is no cause for alarm. In this condition the emergency gear extension valve acts as a bypass.

Refilling Hydraulic Reservoir in Flight.

The hydraulic reservoir may be refilled in flight through the auxiliary filler neck located under the lower bunk at the aft end of the crew compartment. If considerable fluid has been lost due to a leak in a

subsystem, it is advisable to refill the hydraulic reservoir. If a hydraulic leak is known to exist in the main system, there is no reason for refilling the reservoir, since the additional fluid would be lost. To service the hydraulic reservoir in flight, proceed as follows:

1. Bypass valve handle — UP.
2. Loosen the hydraulic vent line cap enough to relieve system air pressure.
3. Remove the vent line cap and filler neck cap.
4. Attach the funnel assembly (stowed adjacent to filler neck) and fill the reservoir with hydraulic fluid. Proper level can be ascertained by checking the quantity sight gage on the reservoir on early aircraft, or the hydraulic fluid quantity indicator mounted on the upper instrument panel on late aircraft.

Note

In an emergency, any fluid except gasoline may be used to fill the hydraulic reservoir. When other than hydraulic fluid is used, make a notation in AFTO, Form 781 so that the system may be purged.

WING FLAPS FAILURE.

For emergency operation of the wing flaps refer to hydraulic power system failure, this section.

LANDING GEAR FAILURE.

For emergency operation of the landing gear refer to hydraulic power system failure, this section.

BRAKE SYSTEM FAILURE.

For emergency operation of the brake system refer to hydraulic power system failure, this section.